United States Department of Agriculture

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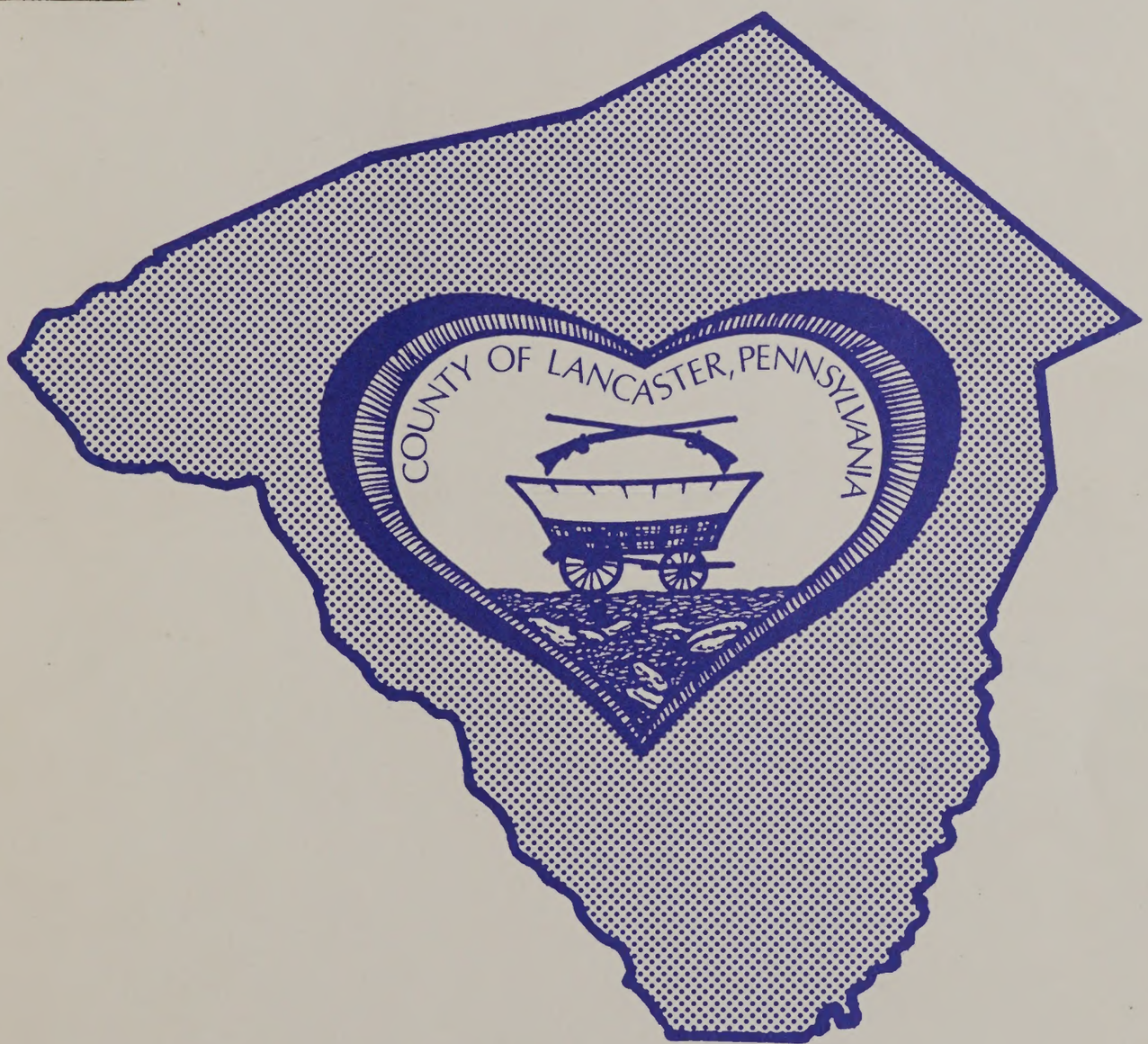
Lancaster Area Land & Water Resources Study

MAIN REPORT



IN COOPERATION WITH THE LANCASTER COUNTY COMMISSIONERS & THE LANCASTER CONSERVATION DISTRICT

LANCASTER AREA LAND AND WATER RESOURCES STUDY

PREPARED BY

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

ECONOMIC RESEARCH SERVICE

FOREST SERVICE

IN COOPERATION WITH

LANCASTER COUNTY COMMISSIONERS

LANCASTER CONSERVATION DISTRICT

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PREFACE

This report represents the results of a study of land and water resource problems and concerns in the Lancaster area of Southeastern Pennsylvania. The study was conducted by the U. S. Department of Agriculture in cooperation with the Lancaster County Commissioners, Lancaster Conservation District, and the Lancaster Chamber of Commerce and Industry.

Lancaster County's industrial and commercial sectors are competing with agriculture for available land. The sponsors wanted this study to address these conflicts in land utilization. This was done by developing a data base for evaluating and analyzing the loss of prime agricultural land, the economic interdependencies between sectors of the study area, the impacts of alternative growth schemes and their effect on agriculture.

Special interest was expressed in developing a resource retrieval and analysis system for the up-to-date appraisal and evaluation of water and land measures in the county. This system was developed with the County Planning Commission and is compatible with the county's computer facilities.

Authority

Authority for this study is Section 6 of Public Law 566, 83rd Congress, as amended. The study was coordinated with other Federal and State agencies. The work was carried out within USDA in accordance with Memorandum of Understanding RB-2 (Rev.), dated May 6, 1978, between the Soil Conservation Service (SCS), Forest Service (FS), and the Economic Research Service (ERS).

Participants

Study participants consisted of USDA agencies - SCS, FS, and ERS, as well as the Lancaster County Planning Commission (LCPC), Lancaster Conservation District (LCD), and the Lancaster Chamber of Commerce and Industry (LCCI).

Responsibilities

The study was carried out under the general guidance of a USDA Field Advisory Committee (FAC), composed of a representative from the SCS, FS, and ERS. The SCS provided leadership in carrying out USDA responsibilities. Each agency had responsibilities for certain portions of the study as outlined in a plan of work approved by the FAC.

Implementation

Information presented in this report will be used by the whole Lancaster County community to help determine the social and economic consequences of decisions regarding land use. This will enable them to guide development and avoid conflicts between urban and rural uses of prime agricultural land.

The retrieval and analysis system will provide the capability for up-to-date appraisal and evaluation of resources and will establish a base for future monitoring of water and related land resources within the study area.

APPENDICES

(Individually Bound)

A. Automated Resource Information Systems

B. Erosion and Sediment Report

C. Livestock Waste Management Report

D. Flood Prevention and Storm Water Management Report

E. Water Quality and Quantity Report

F. Fish and Wildlife Resources Report

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H. Procedures for Developing Economic Surveys and Data

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SUMMARY

This report presents the results of the Lancaster Area Land and Water Resources Study. This Study was conducted by the U. S. Department of Agriculture in cooperation with the Lancaster County Commissioners and the Lancaster Conservation District. The principal objectives of the Study were to:

1. Identify and analyze land use conflicts.

2. Provide analytical methods to assist in making decisions about the county's future development.

3. Develop a data base to understand changes in the use and quality of land and water.

Location and Description

Lancaster County is located in the southeastern part of Pennsylvania and is situated along the western fringe of the eastern seaboard megalopolis between Philadelphia and Baltimore (see Figure IV.1). With a land area of 603,800 acres, Lancaster County is the 12th largest of the 67 counties in Pennsylvania. The county also includes 20,800 acres of water, primarily the Susquehanna River, that forms the western boundary.

Lancaster County is comprised of 12 major watersheds, 11 of which drain into the Susquehanna River. The 12th watershed comprises the headwaters of the Brandywine Creek in the northeastern part of the county. The Brandywine eventually drains into the Delaware River.

Problems and Concerns

Major resource problems and concerns identified include competition for the use of agricultural land, water supply and demand, erosion and sedimentation, flooding, livestock manure management, and fish and wildlife.

Lancaster County experienced the third highest population growth in Pennsylvania during the decade of the 1970's with a 13 percent increase in population (320,079 in 1970; 362,346 in 1980). During this same 10-year period, an average of about 5,000 acres per year of farmland was taken out of production with most of the development occurring on prime agricultural land.

In general, the county has adequate supplies of water for agricultural, residential, commercial and industrial uses. However, recent drought conditions and continuing steady growth have created concern regarding several water quality and quantity issues. Additional development plus an ever-expanding livestock industry have created a concern over the quality of the ground water being withdrawn.

Cropland in the county is eroding at an average annual rate of 9.2 tons per acre. This high rate of soil loss is attributed to a lack of conservation practices plus intensive row cropping on highly erodible soils. The bulk of the sediment delivered to the county streams comes from only two sources: cropland erosion and streambank erosion.

Average annual floodwater damages in Lancaster County are just slightly less than $1 million. In addition, problems associated with storm water runoff are becoming increasingly serious.

Annually, approximately 4 million tons of livestock manure are produced in the county. The bulk of this manure is applied to the land and is ecologically acceptable when done properly. The indiscriminate disposal of livestock manure is a growing concern.

Lancaster County has a variety of very significant wildlife habitats. The loss of these habitats is a concern. There are, on the other hand, many opportunities to improve and enhance the existing but less significant habitats.

Possible Future Scenarios

Seven future land use scenarios for the year 2010 were developed. The first, the predicted future scenario, is simply an extension of current trends. Three alternative growth patterns, preferred agriculture development, preferred urban development, and a mixture of the two are presented. Each growth pattern is further broken down into a more efficient and less efficient option to create the other six scenarios. These are constructed to demonstrate the interrelation between the efficiency of land use and gross economic activity. Each scenario can be examined to compare with Lancaster County's goals for economic well-being.

Planning Implications

Analytical methods were developed to assist in making decisions about Lancaster County's future development. This study did not identify a preferred scenario, nor develop a program for implementing any of the scenarios. Selecting and implementing a scenario is the responsibility of local governments and concerned county residents.

Selecting a scenario requires a close examination of the assumptions used during development. The methods are located in the 11 appendicies and the data are stored on the Lancaster County computer. A program (Geographic Information System) for the utilization of this data is also available on the county computer.

The only identifiable problem and concern that can be addressed directly by the USDA agencies is the one of soil erosion. A number of Federal, State, and local agencies and organizations have programs that can be used to address other concerns.

CHAPTER I

CHAPTER I - PROBLEMS AND CONCERNS

A. INTRODUCTION

Decisionmakers, especially public ones, are under tremendous pressure to make enlightened decisions on the use of land. However, their ability to identify and make these enlightened decisions as well as evaluate land use alternatives remains limited. This is particularly crucial when it is recognized that land use decisions have a high degree of permanence and, in many cases, may be irreversible.

It is in this context that concerned individuals and decisionmakers in the county requested aid from the United States Department of Agriculture to conduct a comprehensive study of the county. It is anticipated that the results of this study should provide public officials and other concerned individuals with decisionmaking tools which could aid in making decisions concerning long-term alternative land use scenarios. Table I.1 gives a brief summary of current and projected conditions.

B. COMPETITION FOR THE USE OF AGRICULTURE LAND

Lancaster County is one of the most prosperous agricultural counties in the Nation. With products valued at $406 million in 1978, agriculture is one of the leading industries in the county, and employs directly or indirectly, approximately 10 percent of the county's work force. Another factor in the importance of agriculture is that almost one-third of the Nation's population is within 200 miles of Lancaster County farmers.

Good soils, favorable climate, productive farmers, and the close proximity to markets would seem to be the perfect setting for strong, viable agriculture. But, there are other factors which question this picture of prosperity.

Economic development has been both beneficial and destructive in the county. Diversification has allowed a greater choice in the selection of available goods, services, housing, and employment. This diversified development has also created a more stable and balanced economic base in the county. As a result, an expanding economic opportunity and a high quality of life continue to attract visitors, new residents, and new industries. The new residents contribute to the vitality of the community and provide a fresh approach to problem solving due to their abilities and skills. However, the increasing flood of economic development has resulted in a steady loss of agricultural land.

Farmland which once covered around 90 percent of the county's land area now covers approximately 70 percent. The bulk of this lost agricultural land was developed into new residential areas with smaller amounts of land being devoted to shopping centers, industrial parks, schools, and roads. Industries increased from 665 in 1972 to 762 in 1978, and the number of retail establishments increased from 1,769 in 1972 to 3,206 in 1978.

Lancaster County experienced the third highest population growth in Pennsylvania during the decade of the 1970's, with a 13 percent increase in population (320,079 in 1970; 362,346 in 1980). With the population increase was an increase in housing units, from 100,771 in 1970 to 129,368 in 1980. All rural townships increased in population, while many boroughs decreased. The most dramatic increase was in Providence Township, a rural township approximately 10 miles south of Lancaster. Their population increased from 2,842 to 4,778 and housing units practically doubled, from 849 to 1,664.

TABLE I.1 - PRESENT AND PROJECTED CONDITIONS, PROBLEMS AND CONCERNS
LANCASTER AREA LAND AND WATER RESOURCES STUDY

Item	Unit	Year	
		1978	2010
Land Use Changes	Acres		
Urban Land 1/		83,800	123,800
Rural Land 2/		520,000	480,000
Population *	Number	362,000	480,000
Water Supply *	mgd 3/	29	76
Cropland Erosion	1000 Tons	3,330	2,436
Flood Damages *	Dollars		
Average Annual		921,000	14,233,000
100-year		1,225,000	18,930,000
Farm Livestock *	Animals		
Cattle and Calves		237,000	330,000
Swine		257,000	500,000
Poultry Layers		7,300,000	14,000,000
Poultry Broilers 4/		36,000,000	60,000,000
Livestock Manure Production *	Tons/year	4,075,000	5,684,000

1/ Includes residential, commercial, industrial, institutional, and utility land plus a category of land in mixed uses.
2/ Includes woodland, brushland, farmland and wetland.
3/ mgd - Million gallons per day.
4/ Includes 4½ batches per year.
* 1980 Figures

During this same 10-year period, an average of about 5,000 acres per year of farmland was taken out of production.

Most recent developments occurred on prime agricultural soils. Also, much of the development was of low density in nature and was scattered along highways throughout the county. Due to this low density development, less efficient systems for transportation, public utilities, and community facilities and services were provided.

Agricultural Economy

Due to fertile soils and excellent farming techniques, the agricultural sector is a major contributor to the county's prosperity. It annually ranks as Pennsylvania's leading producer of corn, hay, tobacco, milk, poultry, cattle, and hogs. It also ranks among the 10 leading counties which produce wheat, barley, peaches, and potatoes.

In 1978, the U. S. Census of Agriculture estimated that the value of agricultural products sold by Lancaster County farmers was $406 million. This estimated market value of agriculture can be subdivided by returns from livestock and crops as follows: $355 million from livestock and poultry products, $13 million from small grain crops, $16 million from tobacco crops, $11 million from nursery and greenhouse products, $5 million from field seeds, hay, forage, and silage crops, and $6 million from all other crops.

There is also a great diversity in the way Lancaster County farms are organized and managed. Intensive specialized production is common. Many of these farms emphasize one or two crops and/or livestock enterprises such as dairy or poultry. On the other hand, some farms such as a number of large poultry units use relatively large amounts of purchased inputs such as machinery, feeds, and chemicals and finance a larger part of their own operations with loans. Other farms which are labor-intensive grow most of their feed, use horses or mules and not tractors for their mobile power, and use their own money to purchase other farm inputs.

Land Use

Many of the county's goals and objectives relate to the use of land. Their attainment usually affects the use of land and is often constrained by availability of land or conflicts in land use.

Economic growth, employment, social equity, environmental quality in the production of food, fiber and services, all have strong land use implications. There are a variety of conflicting forces in Lancaster County, including institutions, technology, and individual and group preferences. Each of these preferences affect the demand for land, its supply and allocation among alternative uses.

Land use issues are dynamic since data and information required for decisionmaking are continually changing. In fact, possession of land and how it is used increasingly affects the whole of society. The interdependency among land uses and individuals or entities in the use of land are increasingly evident.

For example, nonagricultural demands for land affect the economic viability of the agricultural sector. Agricultural production practices affect the quality of urban and rural environments. A spatial distribution of economic growth affects housing costs, employment opportunities, cost of public services, air and water quality, and availability of land for agriculture.

A greater awareness of these interdependencies and the increased competition for land caused by increased population, income, and mobility, have elevated land use on the list of social priorities. Different uses of land become more competitive and this competition has generated controversy. In Lancaster County, an increasing number of instances have occurred in which the public's perception of desirable land use differs significantly from the result of market transactions and landowner decisions. Hence, the need for rational conflict resolution has increased.

Land Use Interdependencies

a. Agricultural Related Industries

A prosperous agricultural economy, an excellent transportation network, plus readily available markets are essential components for the large number of agricultural related industries in Lancaster County. Many of these industries grew-up supporting the local farm community, but have expanded in the last few years to support farmers in surrounding counties as well as surrounding States.

Having the large number of agriculture support industries located in the county is advantageous to local farmers and the local economy. Many of these firms buy their raw materials directly from the farmer and, at the same time, provide large numbers of jobs for others who are not engaged in farming. These companies also buy raw agricultural products out of the county and sell them in the county. Other firms can test their products locally before making them available in other areas. As a result, Lancaster County farmers are the recipients of the latest in technology and information giving them a distinct edge over their competitors.

Lancaster County's high-value agricultural production makes it possible for a large number of agriculture-dependent companies to flourish. It is important that agriculture and its related industries remain strong in the county.

b. Recreation and Tourism

The number of tourists visiting Lancaster County each year and the tourism industry in Lancaster County have increased significantly over the past several years. The first survey of tourism by the Lancaster Chamber of Commerce was taken in 1963. In that year, it was estimated that about one and one-half million people visited the county. In 1970 and 1971, the estimated number was about three million. Many new motels, hotels and restaurants have been constructed since the early 1960s to accommodate tourists in the county. The U. S. Travel Data Center estimated that in 1978 a total of 2.8 million tourists spent approximately $232 million dollars in the county. The tourist industry employed 8,300 employees with an annual payroll of $48,600,000. The total number of motel and hotel rooms in 1978 was estimated to be 4,200.

However, the development of tourism among the Amish communities has created a situation in which the Amish are potentially vulnerable. Between the tourists and the Amish, there is a strong culture

difference that delineates two different realities. Many Amish fear that tourism could eventually engulf and destroy the Amish community. However, a recent study of tourist enterprises in Lancaster County has suggested that if the boundaries can be maintained between the Amish and the tourist enterprises, both may survive and benefit from each other. The Amish culture and countryside were originally the major attractions for tourism, but many other attractions are now reducing the impact of tourism upon the Amish culture.

Social, Historical and Cultural Concerns

The importance of agriculture in the county can be viewed through its heritage. Farming has always been highly diversified. There has always been a contrast between a labor-intensive and the more mechanized types of farming. The Amish and Mennonites farm today as their fathers did before them. They use a minimum of fuel-powered machinery, making their farming operations labor-intensive. Yet, they are as organized and productive as the other farmers in the county.

A typical Amish farm maintains livestock of various kinds such as horses, mules, dairy cows, beef cattle, hogs, poultry and sheep. Tobacco is grown by many Amish farmers as a cash crop. In addition, the diversified vegetable garden and the production of milk, cheese, fruit, cereals, and meat have aided the Amish in achieving a high degree of self-sufficiency.

Currently, the Amish are dividing their farms in order to keep the young people on the farm and are buying farms from the non-Amish landowners as they are available. They have also been willing to pay higher prices for new land adjacent to their existing farms. The Amish prefer to live together in reasonable proximity since their horse and buggy travel limits the distance they can conveniently travel.

The combination of diminishing farm size and the high price of land in connection with the price fluctuations during critical periods have forced the Amish into a more intensive farming program. The result has been an increase in specialized farming, raising crops for cash, such as tobacco, potatoes, tomatoes, cantaloupes, and peas.

C. WATER SUPPLY AND DEMAND

In general, the study area is fortunate to have adequate supplies of water for agricultural, residential, commercial and industrial uses. However, recent drought conditions and continuing steady growth in Lancaster County have caused concern regarding several water quality and quantity issues. As additional development occurs, concern over potential surface and groundwater pollution increases and depletion of supplies becomes a critical issue.

Urban Water Use

Water is available from either surface or groundwater sources. The major surface water source in the county is the Susquehanna River. Other significant surface water sources are the Conestoga River and the Conewago, Conoy, Chickies, Pequea, Conowingo and Octoraro Creeks. The greatest potential for groundwater lies in the northern half of the county where the area is underlain by limestone and well yields are often high. However, with proper site selection, all areas of the county should produce acceptable yields.

Lancaster County's public water agencies supplied nearly 23 million gallons per day (mgd) in 1964 and were supplying in excess of 29 mgd in 1980. Demands for this supply come from residential, industrial, commercial and agricultural users. In addition, industrial water usage was 3.5 mgd in 1964 and is projected to rise to 12 mgd in 2010.

Rural and Agricultural Water Use

The population of Lancaster County is 362,346 of which about 164,580 reside in rural areas 1/. Water supply sources for rural and agricultural use come from the Susquehanna River and tributaries, several water supply reservoirs, and groundwater supplies.

The three categories of water usage for rural areas, as shown on Table I.2, are domestic, livestock, and irrigation. Domestic use accounts for about 10,533 mgd. The livestock requirement which includes water use for consumption and washing is about 9.393 mgd. The largest use in this category is for milk cows, cattle and calves, hogs, and poultry. Irrigation usage for a 90-day growing season is about 34.618 mgd. Due to the reliability of rainfall, irrigation is not normally practiced in the county except upon high value crops such as vegetables. The total annual rural and agricultural water use is estimated to be 10,388.654 mg.

In the past, groundwater contamination has not been a severe problem. However, as development and agriculture intensified in the county, there has been a growing concern over the quality of the groundwater being withdrawn. The primary groundwater contamination trouble spots can usually be located in areas with underlying carbonate rock formations (limestone areas). Because of the solubility of these rocks, many of the fractures, joints, and fault zones develop into large interconnecting solution cavities that extend over large areas. These act as subsurface conduits for groundwater movement and frequently have surface water access (sinkholes). Any pollutant getting into the groundwater can often travel great distances, polluting many wells along the way.

Lancaster County is particularly fortunate in having extensive groundwater resources, but extreme care should be taken to keep them from becoming polluted and unfit for use. The same is true for the surface water resources of the county.

1/ Based on 1980 Census.

TABLE I.2 - RURAL AND AGRICULTURAL WATER USE, 1980

Item	Number	Usage Rate (gpd)	Gallons Used (mgd)	Annual Use (mg/yr.)
Rural Population:	164,580 1/	64 2/	10.533	3,844.589
Livestock:				
Cattle and Calves	154,705 3/	15 4/	2.321	847.165
Milk Cows	82,295	40	3.292	1,201.580
Horses and Ponies	7,000	12	.084	30.660
Swine	257,000	6	2.022	738.030
Sheep	6,000	3	.018	6.570
Poultry 5/	11,042,200	0.15	1.656	604.440
Subtotal			9.393	3,428.445
Irrigation: (Based on 90-day growing season in 1980)			34.618 2/	3,115.620
Total				10,388.654

gpd - gallons per day
mgd - million gallons per day
mg - million gallons

1/ Based on 1980 census
2/ Based on rates from "The State Water Plan," 1980.
3/ Based on livestock numbers in both the "Pennsylvania Crop & Livestock Annual Summary," Pennsylvania Crop Report Service, and the 1978 Census of Agriculture.
4/ Based on rates from "Pennsylvania Analytical Summary, 1978, USDA-SCS, Harrisburg, Pennsylvania."
5/ This figure includes both layers and broilers and represents the total number on hand at any one time.

D. EROSION AND SEDIMENTATION

Soil erosion is one of the major resource problems and concerns in Lancaster County. Erosion decreases the productive capacity of the land through the loss of valuable topsoil, changes in soil structure, and exposure of less productive soil materials. Soil damaged by erosion requires more energy inputs to maintain the same productivity and income.

The sediment resulting from erosion impairs the quality of the water resources in which it is entrained and often degrades the location where it is deposited. It may carry pesticides, toxic metals, and plant nutrients attached to the soil particles. As a result, sediment is one of the major pollutants of surface water in the county.

Estimated Erosion

The total or gross annual erosion in Lancaster County is estimated to be greater than 4 million tons. Table I.3 summarizes this erosion and indicates that the primary sources are sheet and rill erosion on cropland and bank erosion along the streams.

Table I.3 - EROSION SUMMARY, LANCASTER COUNTY

	Acres	Tons/Acre	Tons	Percent
Sheet and Rill Erosion Sources				
Cropland	362,000 1/	9.2	3,330,400	74.7
Pastureland	68,071 1/	0.99	67,390	1.5
Woodland	99,100 2/	0.66	65,010	1.5
Urban and Other	75,229	0.5	37,614	.8
Subtotal	604,400		3,500,414	78.5
Other Erosion Sources				
Streambanks			784,860	17.6
Gullies			97,560	2.2
Ditches			38,280	.8
Construction Sites			28,580	.6
Roads and Roadsides			11,160	.3
Subtotal			960,440	21.5
Total			4,460,854	100.0

Source: SCS National Resources Inventory 1979-1980

1/ Acreages adjusted to coincide with figures in the 1978 Agricultural Census

2/ Includes some residential land.

Approximately 60 percent of the county's land area is classified as cropland and has an average annual erosion rate of 9.2 tons per acre. This high rate of soil loss is attributed to a lack of conservation practices and intensive cropping such as corn. It is estimated that 76 percent (275,000 acres) of the cropland needs conservation treatment. The number of acres planted to corn has increased 77 percent in a period of 20 years while close-growing crops have declined. This change is displayed in Table I.4.

TABLE I.4 - CHANGE IN ACREAGES OF PRINCIPAL CROPS GROWN IN LANCASTER COUNTY

Crop	1960	1970	1980
Corn	113,500	142,600	200,700
Wheat	58,400	36,300	28,500
Barley	20,800	23,500	8,600
Hay	97,000	89,200	81,800

Source: Pennsylvania Annual Crop and Livestock Summary, 1960, 1970 and 1980.

Pastureland in the county is estimated to be eroding at an average annual rate of 0.99 tons per acre while the woodland is estimated to be averaging 0.66 tons per acre. These rates are considerably below the State averages and erosion from these sources is not considered to be a problem.

Streambank erosion contributes 17.6 percent of the gross annual erosion taking place in the county, while gully and surface drainage ditch, roads and roadsides contribute toward the remaining 3.9 percent of the total. Much of the streambank erosion is a result of natural processes, but a significant amount can be attributed to livestock grazing along the streambanks. An increase in surface water runoff from urbanization also has an effect.

Sediment

The major sources of sediment are soil erosion from cropland and streambanks. Although some sediment from cropland is entrapped in sod filter strips, field depressions, and drainage ditches, a significant amount reaches the streams, lakes and rivers. Although only 17.6 percent of the gross erosion is contributed by streambanks, nearly all of this soil goes directly into the streams.

Lancaster County drains into the Susquehanna River via several subbasins. These basins are the Octoraro, Pequea, Chickies, Conewago and Conowingo Creeks, plus the Conestoga River. Based on suspended sediment measurements by the U. S. Geological Survey on the Pequea Creek Basin, a sediment delivery ratio of 18 percent is estimated. This results in an estimated annual gross sediment delivery of 803,000 tons to the receiving streams. Although all of the basins empty into the Susquehanna, it is expected that something less is delivered to the river due to sediment accumulations in the streams and reservoirs along the way. The recently completed Chesapeake Bay Study identified the Susquehanna River as a major contributor of nitrogen, phosphorous and sediment to the bay each year. Lancaster County, due to its location, erodible soils, intensive cropping patterns and large numbers of livestock, is a major contributor of nutrients and sediment to the Susquehanna.

Spiraling costs in the agricultural industry are resulting in a trend toward more intensive production practices. Lancaster County has one of the heaviest concentrations of livestock and poultry in the country. As a result, more and more corn is being grown. This trend is expected to

continue in the future. If soil erosion is to be controlled, then more conservation practices must be installed on the land. It is possible not only to maintain but to increase both corn production and livestock production while keeping erosion to acceptable levels.

E. FLOOD DAMAGES

Floods are natural occurrences that cause property damage and loss of life, primarily, as a result of man's use of and encroachment upon the flood plains. The most destructive flood occurred in Lancaster County in 1972 as a result of Tropical Storm Agnes. Property damages amounted to over $29 million and 10 lives were lost. Despite these staggering losses, valuable residential, commercial and industrial developments continue to be built and/or rebuilt in floodprone areas. Flooding problems and damages were analyzed throughout the county. Average annual and 100-year storm damages for 1980 and the year 2010 are displayed in Table I.5. Damages are based on 1980 dollars.

TABLE I.5 - ESTIMATED FLOODWATER DAMAGES IN LANCASTER COUNTY

Year	Average Annual Damages (Dollars)	100-Year Damages (Dollars)
1980	921,460	14,233,180
2010	1,225,500	18,930,000

Flood damages to residential, commercial and industrial properties occur primarily from the destructive velocity of water, depth and duration of inundation, and deposits of sediment and debris. Most of the losses are from damage to the structures and contents and the costs required for clean-up, repairs, and replacement of damaged items.

Principal agricultural damages are to crops, pastures, fences, and farm improvements. Crop and pasture damages occur from overflows and sediment deposits that destroy plants, retard development, and prevent timely planting and harvesting operations. The loss from flood damage results from reduced income, increased production costs, and cost of repairs, replacement and restoration of damaged items. Agricultural crops and pasture damages are estimated to average over 21 thousand dollars annually (see Table I.6). More detailed floodwater damages are described in Appendix D, Flood Prevention and Storm Water Management Report.

In addition to major floods, problems associated with storm water runoff are becoming increasingly serious. Development actions such as the construction of buildings, removal of vegetation, and large scale resurfacing and drainage systems plus encroachment upon floodprone lands are creating new flooding problems and aggravating existing ones.

Damages from future floods are expected to increase because of the increasing value of damageable items, accelerating repair costs, and intensification of land use. However, no floodprone areas in the county were identified that would be eligible for Public Law 566 Watershed Protection and Flood Control Projects of a structural nature. For this reason, flooding was not addressed in Chapter II, and no analysis of alternatives was made.

TABLE I.6 - ESTIMATED FLOODWATER DAMAGES IN 1980 DOLLARS
FOR LANCASTER COUNTY

	Basin 1/	Crops and Pasture	Residential and Commercial	Road and Bridge	Total
Average Annual Damages	G	2,960	199,150	4,330	206,460
	J	12,200	536,030	11,270	559,500
	K	5,860	146,520	3,140	155,520
	County Total	21,020	881,700	18,740	921,460
100-Year Damages	G	13,770	3,856,900	78,750	3,949,420
	J	56,720	8,037,400	204,490	8,298,910
	K	27,250	1,900,500	57,100	1,984,850
	County Total	97,740	13,794,800	340,640	14,233,180

1/ Basins are defined in the State Water Plan, Subbasin 7, Lower Susquehanna River.

F. LIVESTOCK MANURE MANAGEMENT

Historically, Lancaster County has always had significant numbers of livestock and poultry, but the period from 1960 to 1980 was one of great expansion (Table I.7). This expansion came about, in part, because of a diminishing supply of available land and a need to expand farm operations.

Pressures on the land from competing land uses have driven-up the cost of farmland and have caused agricultural land to be converted to other uses. The intensity of competition between urban, agricultural, industrial, and recreational interests is increasing.

As a result of this competition, Lancaster County farmers who wish to expand often have no alternative other than increasing animal numbers. The Amish people in the county have strong religious ties to the land and want to see their sons and daughters remain on the land as well. Since very little land is available, larger farms are divided into smaller units. This trend to smaller farms and high animal numbers on limited acreage is putting a tremendous strain on land and water resources. Crop rotations give way to continuous row crops and the ever-growing numbers of livestock create vast amounts of waste that must be disposed of.

Approximately 4.1 million tons of livestock manures are produced annually in the county. This is enough manure to cover each acre of cropland with 11.2 tons. The most common method of disposing of these wastes is application to the land. It is ecologically acceptable and usually lowest in cost.

When livestock manures are applied in proper amounts, they improve soil fertility and increase crop yields. Carelessly handled, they impair soil productivity, degrade the quality of surface and groundwater, and cause nuisance complaints by neighbors.

At the present time, some of these animal manures are being improperly or indiscriminately applied. As a result, the landowner is not receving the full benefit from the animal manure and, in many cases, receives complaints from offended neighbors and governing officials.

It is expected that the livestock industry in the county will continue to expand, but, probably not as rapidly as in the past. Some townships in the county are planning or have already adopted regulations to control the locations of high density facilities. High interest rates and low prices are also having an effect. Analysis of alternatives for livestock manure management will not be made since this issue was not an original objective of this Study. However, livestock manure management does raise important problems which should be addressed in the future.

TABLE I.7 - GROWTH OF LIVESTOCK AND POULTRY INDUSTRY IN LANCASTER COUNTY

Animal	1960 Numbers	1980 Numbers	20 Years Difference
Dairy Cows	64,000	94,000	+30,000
Cattle and Calves 1/	161,200	289,000	+127,800
Swine	44,000	337,000	+293,000
Poultry, Layers	3,100,000	7,579,400	+4,479,400
Poultry, Broilers	4,004,000	42,106,000	+38,102,000

1/ Includes dairy replacement cows.

Source: Pennsylvania Annual Crop and Livestock Summary, 1960 and 1980. Numbers provided by Lancaster County Extension Service.

G. FISH AND WILDLIFE

Wildlife has a number of direct and indirect benefits to the county's human population. Once a major source of food, wildlife now serves humans in many recreational ways, including hunting and fishing. Wildlife populations and their ability to survive in the natural areas of the county also serve as an indicator of change to fragile ecosystems of which humans are a part.

Lancaster County's variety of wildlife habitat areas support a diversity of game and nongame species, including several species on the Federal Endangered Species list. The amount of wildlife and diversity of species are dependent upon the maintenance of both habitats and favorable environmental conditions. This study, unlike others, was not concerned with inventorying species and counting wildlife populations. The concentration of the study was on wildlife habitats, their size, location, and ability to support wildlife species.

For purposes of this study, very significant wildlife habitats have been categorized as either unique or important. The term "unique habitat" implies something quite rare, unusual, or one of a kind. The term "important habitat" is defined as a habitat in short supply and worthy of special consideration. Other valuable wildlife habitats have been defined and identified under a more general habitat classification system consisting of eight generalized habitat zones. The designation and classification of habitats is valuable in order to assess the conservation or preservation priority as well as the protection options of each area.

Three of the four areas classified as "unique habitats" are protected by government actions:

1. The Middle Creek Wildlife Management Area owned by the Commonwealth.

2. The serpentine barrens of Fulton Township zoned for open space.

3. River islands in the Susquehanna River protected by municipal conservation and flood plain zoning.

The fourth unique area is composed of the six glens along the Susquehanna River. These glens are, generally, too steep for development and the owners presently manage their natural features in ways that afford protection, at least for the short term.

The "important habitat" types are Lancaster County's last extensive natural areas, and the protection of these areas is less certain. The "important habitat" types are listed below with a brief statement of their significance:

1. Threatened and Endangered Species Habitat - Those areas able to support endangered species should be preserved to prevent species' extinction, e.g. White Oak Sanctuary - bog turtle habitat.

2. Wildlife Preserves and Conservation Areas - These areas are preserved or managed for maintenance or enhancement of wildlife, e.g. Boyer Nature Preserve.

3. Wetlands - Wetlands are limited in number and provide habitats for a large number of species.

4. High Quality Watersheds - These watersheds provide high quality water and an environment supporting cold water fisheries.

5. Areas of Scientific or Educational Value - These areas provide striking examples of biological or earth science phenomenon.

6. Woodlands of 100 or More Acres - These are the last remaining large forested areas.

7. Unique Geological Formations - Unusual and scientifically significant formations, e.g. Wind Cave, the river islands.

The conversion pressures on the county's "important habitat" vary, as illustrated by the Table I.8., due to the area's physical characteristics, government regulations pertaining to the site, ownership, and proximity to existing development. This conversion pressure analysis aids in understanding how vulnerable the habitats are to conversion due to inadequate protection. This analysis may be useful, in a general way, in setting priorities for public and private actions, but conversion pressures and options for protection are site specific and, therefore, beyond the scope of this study.

TABLE I.8 - CONVERSION PRESSURES ON IMPORTANT HABITATS

Important Habitat Type	Ag Conversion	Other Development	Types of Impediment
Endangered Species Habitat	M (medium)	L (low)	High ground water table, floodway.
Wildlife Preserves and Conservation Areas	L	L	Public or conservation group ownership.
Wetlands	M-H (high)	L-M	Remoteness and high ground water table.
High Quality Watersheds			
Headwaters	M	M	Remoteness, slope,
Lower Reaches	L	L	and poor soils.
Scientific or Educationally Valuable Sites	Variable with site		
Woodlands	L	L	Generally steep and/or stony.
Unique Geological Formations	L	L	Remoteness, limited in size, flooding.

Most of the study area is comprised of lands not designated as "unique" or "important habitat." These lands, while not individually unique, are quite significant for wildlife in the aggregate. These areas can be classified into eight generalized habitat zones: (1) woodlands, (2) scrub brush, (3) farmland, (4) rural residential, (5) suburban, (6) urban, (7) wetlands and (8) water. Each generalized habitat type is characterized by the species of flora and fauna it contains. Technical Appendix F, Fish and Wildlife Resources Report, describes the habitat types, their predominant species, and the types of management practices which are available to enhance wildlife in that habitat.

The contribution of these generalized habitat areas is difficult to determine. Some areas, such as wetlands and woodlands, play a more significant role than urban and suburban areas, but the effect of these areas in the aggregate, due to their size and location relative to other natural areas, is not well understood. More knowledge of those factors would enable better decisions to be made about the importance of specific areas and the amount of protection desirable to maintain and enhance the county's wildlife resources. The loss of certain types of habitat and their predominant species may be unavoidable in the future, but, on the other hand, innumerable opportunities to improve and enhance wildlife habitat remain to be taken.

CHAPTER II

CHAPTER II - POSSIBLE FUTURE SCENARIOS

A. INTRODUCTION

Decisionmakers in the planning process need more efficient methods for identifying economic problems, setting goals to overcome problems, and predicting goal achievement. Data are needed to strengthen the criteria, standards, and general methodology used in selecting future land use alternatives.

The Lancaster Area Land and Water Resources Study (LALWRS) comprehensively evaluates the current, and estimates the future, economic, socioeconomic, and cultural status of the county in relationship to land utilization and county income. 1/ Interdisciplinary techniques are provided for decisionmakers to use with supplied data to evaluate the direct and indirect impacts which could result from proposed planning alternatives of future land uses in the year 2010.

Local study participants expressed an interest in conducting socioeconomic land use analysis of the county. Interested groups--the Lancaster County Planning Commission (LCPC), the Lancaster Chamber of Commerce and Industry (LCCI), and the Lancaster Conservation District (LCD), in conjunction with the County Commissioners--expressed the need to do an evaluation of the county which would provide data, information, and techniques that they could use as guidelines in evaluating decisions which could affect the future use of land in the county.

This chapter describes the procedures used to determine the 1978 land uses in the county and relate land uses to county income. Future land use scenarios for the year 2010 were evaluated using the tools developed for the study as well as information obtained from local participants and a task force. The task force was made up of county residents appointed by the County Commissioners.

Information relating to each of the future land use scenarios was examined for its effects on county income. Each of these future scenarios was examined for its individual contributions to social and economic county goals and then was compared with one another and the base year. The purpose of this process is to illustrate through simple examples a range of choices available to Lancaster County today by utilizing the methodologies developed during the study.

1/ For the purpose of this study, county income refers to the value of all goods and services produced in the county during a calendar year.

B. PROCEDURE

Data for Lancaster County was studied to determine the geographic location and acreages of current land uses and to estimate their contribution to county income. From this understanding of the present and the projection of historic data trends a reference scenario was constructed for the year 2010. The predicted future scenario is simply an extrapolation or extension of current trends. It serves to define interrelated trends in physical characteristics and economic activities that appear to be the most plausible if we examine recent history with present knowledge.

Two land use preference criteria--a more efficient and a less efficient, and three different growth patterns--preferred agriculture, preferred urban development, and a mixture of the two--were combined to formulate six additional scenarios. These are constructed to demonstrate the interrelated nature of efficiencies in land use and gross economic activity, and are compared with the predicted future and the base year. Each of these scenarios was also examined and compared with Lancaster County's goals for economic well-being, as well as for their environmental and scenic quality implications.

C. 1978 LANCASTER COUNTY DATA BASE

Information on Lancaster County for 1978 was obtained from aerial photographic interpretation, census data, and directly from farmers, industries, households, and government.

Geographic Information System

The Lancaster County Geographic Information System (GIS) contains various computer programs and information files which provide data that can be used to study issues associated with the location of physical features, conditions, and activities in the county. The system includes computer programs to store, retrieve, alter, update, and map information. Programs are also included to perform various arithmetic and simple statistical operations. The GIS system is currently installed and operational on the Lancaster County computer. Appendix A is a user's manual for the system.

1978 Economic Structure of Lancaster County

Information on the economic structure of Lancaster County was obtained from surveys of farms, industries, wholesale and retail trade service establishments, households, governments, and utilities. 1/ A table representing the flow of economic goods and services measured in dollars was developed for Lancaster County for 1978 using the survey data. A computer and computer programs were used to illustrate the dependency of economic activity within and among economic sectors 2/ in Lancaster County for 1978.

Land Uses and Economic Sectors

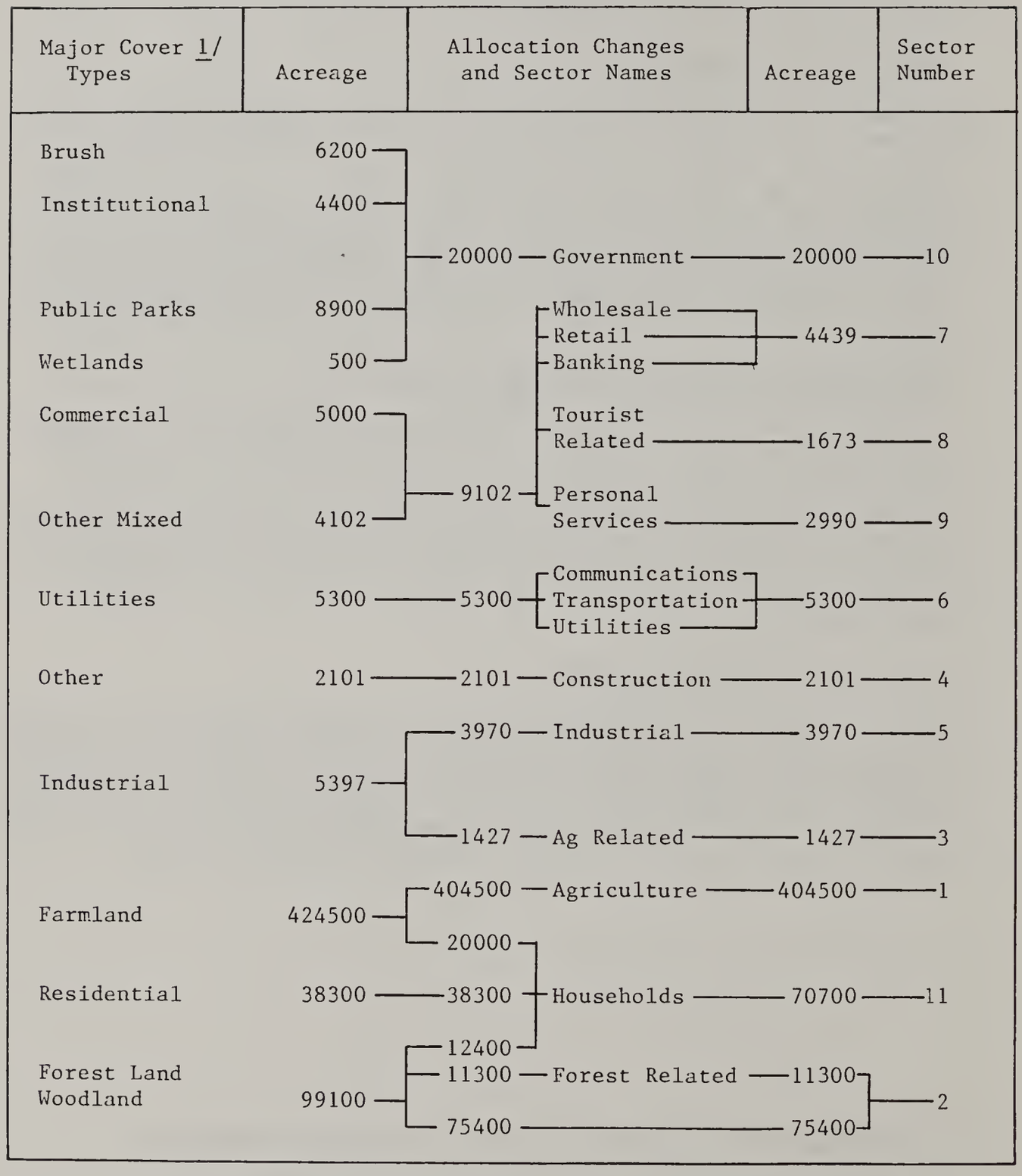
Information derived from the GIS system and from the money flow table was used to relate county income and land use by sector. Figure II.1 relates acreage of land cover by use obtained from the GIS system with acreage allocated by economic sector. Table II.1 contains the value of goods and services per sector (gross income), acreage allocated per sector, and the amount of land required per sector to generate $1000 of income.

1/ Information in Appendix H pertains to sampling procedures.

2/ For the purposes of this study, a sector is defined as a group of firms producing a similar product, Appendix J.

FIGURE II.1 - RELATIONSHIP OF LAND COVER TO ECONOMIC LAND USE CATEGORIES FOR 1978

Acreage Allocated by Major Uses and Combined into 11 Economic Sectors



1/ Cover categories are those defined by photo interpretation for the GIS data base. The acreage for brush and wetlands obtained from the land cover files was assigned to the government economic sector since there was not a separate category for acres of State Game Lands in the land cover file.

TABLE II.1--LANCASTER COUNTY GROSS INCOME AND ACREAGE REQUIRED PER $1000 INCOME FOR AN 11 BY 11 SECTOR MONEY FLOW TABLE FOR 1978

Sector Number	Sector Name	1978 Current Status			
		Land Area Acres	Gross Income 1/ $1,000,000	Acres per $1,000 Income	Income per Acre $1000
1	Agriculture	404,500	406	.996	1.004
2	Forestry Related	86,700	14	6.193	0.163
3	Ag Related Industry	1,427	946	.002	500.00
4	Mining and Construction	2,101	577	.004	250.000
5	Industry	3,970	2,054	.002	500.000
6	Transportation, Utilities	5,300	530	.010	100.00
7	Wholesale, Retail, Banking	4,439	2,625	.002	500.00
8	Tourist Related Services	1,673	159	.011	90.909
9	Other Services	2,990	632	.005	200.000
10	Government Related	20,000	905	.022	45.455
11	Households	70,700	2,270	.031	32.258
	Total	603,800	$11,118		

1/ Income in 1978 dollars

The 1978 Money Flow Table

The 1978 Money Flow Table 1/ of Lancaster County illustrates that approximately $11.1 billion of economic activity was generated in the county for that year, with about 50 percent of this amount being obtained from commodities and services exported outside the county, Table II.2

Commercial businesses and services such as wholesale and retail trade, banking, real estate, insurance, nonpersonal services, etc., generated $2.6 billion. Households generated $2.3 billion and industries, except for agricultural-related industries, generated $2.3 billion. Other sectors contributing to gross county income included agricultural-related industries, government, personal services, construction, utilities, agriculture, tourist-related, and forestry-related services for $946, $905, $632, $577, $530, $406, $159, and $14 million, respectively. The value of exports ranged from a low of about $1 million in the forestry-related sector to a high of $1.8 billion in the commercial sector. Households purchased $1.8 billion of goods and services inside the county. Industry purchased $1.0 billion. Industrial payment to households in the form of salaries and wages amounted to $620 million, the highest of any sector in the county. Direct purchases of intermediate goods by the food processing sector of $227 million from agriculture was the highest in the county.

An Example of Economic Activity Per Dollar of Agricultural Production

The information in Table II.3 illustrates the distribution of a dollar of sales by agriculture among the other sectors (column 2). The coefficients in column 3 illustrate the total economic activity generated by all sectors from a dollar of agricultural exports outside the county ($2.74). The values in column 4 illustrate the volume of economic activity generated in the county from exporting $76 million of agricultural commodities--$207 million. Stated differently, for each additional dollar of agricultural exports, an additional $1.74 of economic activity is generated in the county. The multiplier consists of the direct effect of $1 of additional agricultural exports plus the indirect effects of $1.74

1/ The money flow table is a square matrix with the same number of rows and columns. The corresponding row and column for each sector represent income and expenses, respectively. For example, the table shows that agricultural income was derived from the sale of products to various sectors (i.e. $54.8 million from the agricultural sector itself, $49.7 million from the forest-related sector, $227.5 million from agricultural industries, etc.). The expenditures made by the agricultural sector are then shown in column 1 (i.e. $54.8 million to the agricultural sector itself, $9.9 million to the forest-related sector, $40.9 million to the agricultural industries, etc.). Since the economy is assumed to be in balance (income equals expenditures) the total value of income and expenses for each sector is equal. See Appendix J for more detailed information.

TABLE II.2 - 1978 MONEY FLOW TABLE OF LANCASTER COUNTY
($1,000)

	1	2	3	4	5	6	7
1-Agriculture	54750	4970	227485	1029	1418	0	29265
2-Forestry related	9902	917	969	0	0	0	0
3-Ag industries	40936	0	48546	24303	4405	23552	51383
4-Construction	7363	949	4697	11857	2503	9029	24651
5-Industries	35682	0	7405	119264	83118	2515	35257
6-Utilities	6508	937	26818	58491	15182	5577	7255
7-Commercial	133763	919	85862	140859	186785	22212	195206
8-Tourist	1969	0	3475	2707	6249	0	2593
9-Services	12116	0	25014	7658	48504	7722	37165
10-Government	18809	909	20185	7968	40659	7746	44310
11-Households	19501	3588	168268	109271	620279	83237	422929
Total Internal	341300	13189	618721	483406	1009101	161589	350015
Total External	64701	811	327279	93594	1044899	368411	1774985
Grand Total	406000	14000	946000	577000	2054000	530000	2625000

	8	9	10	11	Total Internal	Exports	Grand Total
1-Agriculture	3666	0	3620	4002	330205	75795	406000
2-Forestry related	0	0	0	1321	13108	892	14000
3-Ag industries	4053	1243	0	48505	246926	699074	946000
4-Construction	1672	6918	43426	134001	247067	329933	577000
5-Industries	0	632	234	0	284106	1769894	2054000
6-Utilities	3851	11967	9843	135123	281556	248444	530000
7-Commercial	74864	112421	63503	374257	1390650	1234349	2625000
8-Tourist	646	1421	484	112188	131730	27270	159000
9-Services	8495	14599	41301	291422	493995	138005	632000
10-Government	8025	9572	53746	107029	318958	586042	905000
11-Households	42063	86341	257295	12928	1825698	444302	2270000
Total Internal	147334	245112	473456	1220776	5564000	0	5564000
Total External	11666	386888	431544	1049224	0	5554000	5554000
Grand Total	159000	632000	905000	2270000	5564000	5554000	11118000

TABLE II.3 - AN EXAMPLE OF ECONOMIC ACTIVITY PER DOLLAR OF AGRICULTURAL PRODUCTION

	Purchases $1,000 1/	Technical Coefficients 2/	Interdependency Coefficients 3/	Interdependency Values $1,000 4/
1-Agriculture	54750.	0.13485298	1.22133002	92570.66
2-Forestry related	9902.	0.02438869	0.03222676	2442.63
3-Ag industries	40936.	0.10082813	0.15454712	11713.89
4-Construction	7363.	0.01813631	0.05627251	4265.17
5-Industries	35682.	0.08788736	0.13368342	10132.53
6-Utilities	6508.	0.01602958	0.05609748	4251.91
7-Commercial	133763.	0.32946599	0.57347092	43466.21
8-Tourist	1969.	0.00484906	0.02271773	1721.89
9-Services	12116.	0.02984185	0.09935361	7530.50
10-Government	18309.	0.04632781	0.09833737	7453.48
11-Households	19501.	0.04803133	0.29586893	22425.37
Total Internal	341300.	.84063909		
Total External	64701.	.15936101		
Grand Total	406000.	1.00000000	2.74390587	207974.24

1/ The values in this column represent the values of purchases by agriculture from other sectors in Lancaster and from outside the county.

2/ The values in this column represent the technical coefficients or direct purchases by agriculture from all sectors in the county for each dollar of total sales by agriculture, i.e., 54750 ÷ 406000 = .13485298.

3/ The values in this column represent the direct and indirect impacts generated in the county for each dollar of agricultural goods and services produced in the county and exported (sold outside the county).

4/ The values in this column represent the total value of direct and indirect impacts in all sectors from the exports of $76 million of agricultural goods and services.

of additional economic activity. An additional 22 cents is generated in its own sector, 3 cents in the forest related sector, 15 cents in the agricultural support sector, 13 cents in the industrial sector, 6 cents in the construction and transportation sectors, respectively, and 10 cents in government and service sectors, respectively, 57 cents in the commercial sector, 30 cents in the household sector, and 2 cents in the tourist related sector. A similar evaluation could be made of all economic sectors in the county; however, these evaluations will be part of the analysis of alternatives which is discussed in Appendix J.

Utilization of data obtained from the geographic information system and other economic procedures provides the necessary tools for the socioeconomic evaluation of the future scenarios. The next section of this chapter establishes the criteria for the seven scenarios for 2010.

D. INFORMATION USED FOR THE 2010 SCENARIOS

Information consistent with the 1978 base year data was evaluated for the previous 30 years. For example, information on census data such as county population, number of farms, average farm size, acreage in farming, number of industries, number of commercial establishments, number of housing units, county income by economic sector, number of employees per farm, firm, and industry, etc., were evaluated to determine general trends in county socioeconomic development and changes in land uses. Appendices H, I, and J discussed this information and general county trends in more detail. However, the main historic factor that relates land use to economic development in Lancaster County is population. Historically, as population increased, more and more land was taken out of agricultural production and used to meet the increased demand for housing units and industrial development. In fact, residential development of land has been the single most important factor in reducing agricultural acreage in Lancaster County.

Therefore, projected population is the most important socioeconomic factor in projecting future land uses and acreage left in agriculture. The seven future land use scenarios are dependent upon projected population in 2010 and how the future population will use land for residential, commercial, industrial, agricultural, and other uses.

Projected Population

Population in Lancaster County is projected to reach 480,000 persons by 2010. This projection is well supported by historical growth of the last three decades. This is an increase of approximately 120,000 people above 1980 level or an increase of approximately 40,000 per decade. This level of population is used in analyzing all of the possible future scenarios. 1/

This increase in numbers of people will mean different land use changes for different estimates of land required by economic sector.

Urban Space Requirement

Since 1950, average household size has declined from 3.50 to 2.83 persons per household. However, this rate of decline is not expected to continue. An average, county-wide household size of 2.75 is predicted for the 30-year period between 1980 and 2010. This implies that a total of about 180,000 housing units will be required by the year 2010, representing approximately 50,000 more units than in the 1980 census of housing. New residential properties are anticipated to require between one-third and one-half acre each. The need for new residences generated by population growth translates into a total land area ranging from 17,000 to 25,000 acres. For the purposes of this study, it is projected that 24,000 acres of additional residential space will be needed by 2010.

1/ Appendix J evaluates two additional scenarios where population is predicted to reach 1.1 and 1.8 million, respectively.

Assuming that residential uses will occupy a similar share of all urban space in the future as they do today, the total potential need for additional urban land will be about 40,000 acres by 2010, Table II.4. 1/ Other urban uses (e.g., land for utilities, public parks, roads, public buildings, etc.,) are allowed to vary in their future share of additional space; they are not necessarily assumed to have the same share in 2010 as they had in 1978. For example, certain urban use categories were anticipated to occupy a smaller share of urban land in the future because of their ability to make more efficient use of existing infrastructure. These other urban use categories include land for utilities and public parks. Industrial and institutional lands are expected to gain a greater share of future urban land.

1/ From 10 to 35 percent of potential urban land demand can be supplied through more efficient utilization of current urban land uses. See Table II.5.

TABLE II.4
CURRENT AND PROJECTED URBAN SPACE REQUIREMENT FOR
1978 AND THE YEAR 2010 1/

Category	Current Status 2/ 1978		Potential New Urban Space Required by 2010 3/	
	(Acres)	(Percent)	(Acres)	(Percent)
Total Residential 4/	50,700	60	+24,000	60
Commercial	5,000	6	+ 3,200	8
Industrial	5,400	7	+ 4,800	12
Institutional	4,400	5	+ 4,000	10
Utilities	5,300	6	+ 1,600	4
Other (mixed) 5/	4,100	5	-	-
Public Parks	8,900	11	+ 2,400	6
TOTAL	83,800	100	+40,000	100

1/ Prepared with the assistance of the Lancaster County Planning Commission.

2/ Estimated from the Lancaster Geographic Information System land cover file which is based on 1978 aerial photography.

3/ Based on an equivalent share in 2010 for the additional 24,000 acres of residential space, total new urban space was estimated as follows:

$$\text{Residential} = .60\ (\text{Total}) = 24{,}000 \text{ acres}$$
$$\text{Total} = 24{,}000/.60$$
$$= 40{,}000 \text{ acres}$$

4/ Includes wooded and unwooded residential use but excludes farmsteads (see Table II.3).

5/ This category resulted from failure to distinguish specific urban categories on the 1978 photography. This mixed category was eliminated from projections of urban space requirements by 2010.

Efficient Use of Land for Urban Purposes

Although urban growth could potentially require an additional 40,000 acres, there are at least three factors which may mitigate the loss of farmland. These can be summarized as follows:

1. Conversion of forest land to satisfy future urban and some agricultural needs.

2. Concentrated or more intensified use of space in existing urban localities.

3. Smaller parcel sizes and denser subdivision development for future residential development on current agricultural land.

The influence of factors such as these, each to varying degrees, will determine the extent to which farmland will be used to satisfy potential urban needs, Table II.5. An alternative which uses less farmland, concentrating urban uses primarily through intensified development in urbanized areas, will be regarded in subsequent discussions as using land more efficiently.

Agricultural Responses to Growth of Urban Areas

There is a great diversity in the way Lancaster County farms are organized and managed. Intensive and specialized production is common. Many of these farms emphasize one or two crops and/or livestock enterprises such as dairy or poultry. Some large poultry farms use relatively large amounts of purchased inputs such as machinery, feeds, and chemicals, and finance a large part of their operations with loans. Other farms are labor-intensive, grow most of their own feed, use horses for their mobile power, and use their own money to purchase other farm inputs.

Generally, most farms have livestock enterprises. Income is largely derived from the sale of livestock and/or livestock products. Annually, since 1950, the value of livestock products have represented an increasing proportion of total sale of agricultural products. In 1978, 90 percent of total farm income was received from the sale of livestock and livestock products.

The trend to increase livestock numbers and enterprises is expected to continue in the future since most farmers currently anticipate that they can increase farm income on less land by increasing animal numbers and purchasing feeds. For example, projections of historic data indicate that cattle and calves will increase from 237,000 in 1978 to 330,000 in 2010; swine from 257,000 to 500,000, poultry layers from 7,300,000 to 14,000,000, and poultry broilers from 36,000,000 in 1978 to 60,000,000 in 2010, respectively.

TABLE II.5 - PROJECTED POPULATION AND ACREAGE SHIFTS IN LAND USE FOR YEAR 2010

Growth Characteristics	Predicted Future	Possible Future Scenarios	
		Scenario A (More efficient)	Scenario B (Less efficient)
Population (number of persons)			
Year 2010	480,000	480,000	480,000
Increase (1980 to 2010)	120,000	120,000	120,000
Land Use Change (acres)			
Total potential urban space required by increased population 1/	40,000 100%	40,000 100%	40,000 100%
Potential need for urban space satisfied by intensified development of existing urban localities 2/	8,000 20%	14,000 2/ 35%	4,000 2/ 10%
Potential urban space absorbed by the use of farmland and woodland	32,000 80%	26,000 65%	36,000 90%
Woodland loss	(8,000)	(12,000)	(4,000)
Farmland loss	(24,000)	(14,000)	(32,000)

1/ Refer to Table II.4.

2/ As the term "urban locality" is used here, it includes Lancaster City as well as more rural towns or villages, subdivisions, strips of residential and commercial development, and industrial parks wherever they may occur. Under a more efficient scenario, 14,000 acres (35%) of the needed land would come from acres already considered "urban localities." Under a less efficient scenario, only 4,000 acres (10%) would come from these areas.

Number and Average Size of Firm by Sector

For convenience of analysis, it was predicted that the average size of firm by sector would remain constant over time; therefore, the number of firms in 2010 would be dependent upon the acreage allocated for each sector. Other assumptions were made for the industrial sectors and commercial, tourist, and service sectors. The total number of firms would be different between the predicted future and other scenarios; however, the total number of firms for industry and combined total for commercial, tourist, and services would be the same for all other scenarios. The number of agricultural related and other industrial firms would change among the scenarios. The subtotal number of firms for commercial, tourist, and personal services would change among the scenarios but their totals would not change.

Location of Future Land Use Change

A change in land use has some impacts which result from the specific placement of that change. The location of future urban development may have at least two general consequences.

First, future urbanization may be located without regard to the location of existing infrastructure (e.g., public sewer and water systems or highway, school, and utility capacity). Scattered development may create the need to extend public services. In addition, funding for such extensions may create a burden for local taxpayers who must pay higher taxes to finance such extensions.

Second, urban development may occur on land that is within the best agricultural areas of the county. This not only removes more productive areas from the agricultural sector of the county's economy, but may become disruptive to agricultural practices and to the vitality or continuation of agricultural activity in those localities.

Anticipating the need to examine the possible spatial arrangement of land use change, a geographic information retrieval system (GIS) was created and implemented during the last year of this study. The use of this GIS has been focused primarily on answering the following questions:

1. How might future land use change be distributed?

2. Will these changes pose any problems for the best agricultural land in the county?

A simple but flexible procedure was followed to answer these questions. Through a series of monthly meetings with the Task Force and the Planning Commission, assumptions and data necessary to implement the procedure were methodically discussed. This approach was intended to give the participants a clear understanding of the procedure, as they may wish to vary or improve upon it in the future. See Appendix K.

E. THE SEVEN FUTURE SCENARIOS

Seven future scenarios were evaluated. Tables II.5 and II.6 contain land use information which was used in developing these scenarios. Acreage in 1978 was obtained from the land cover file of the storage and retrieval computer system for the present status. Land use allocation for the predicted future and scenarios A and B represented the anticipated changes in land use based on historic trends, more efficient use of land, and less efficient use of land, respectively. The predicted future scenario assumed that approximately 8,000 acres of urban land requirement would be satisfied by intensified development of existing urban localities. However, the land use assumption for scenarios A and B required that either 14,000 or 4,000 acres would be needed for urban development. Agricultural and woodland acreage would only be reduced by 26,000 to 36,000 acres, dependent upon the scenario selected. Amounts of agricultural land taken out of production could range from a low of 14,000 to a high of 32,000 acres. Additional woodland required for residential purposes was assumed to range from 4,000 to 12,000 acres under the different scenarios.

The land use classification illustrated in Tables II.5 and II.6 were further organized into groups to better illustrate county production of goods and services according to different economic categories, Table II.6-A. Figure II.1 on page II.4 illustrated the relationship of land cover to economic land use categories. Table II.6-B was obtained by grouping acres of land and sectors of the Lancaster economy. The sectors of the economy and acreage of land use have been grouped into three economic categories and allocated by the seven scenarios. The economic categories include industrial, commercial, and all others. Acreages for the predicted future differ from the other six scenarios by economic category; however, acreage by category is the same for A and B, but vary by subcategory. The information in Table II.6-B illustrates that the only difference between land use efficiencies in A or B is the allocation of land among the subcategories of industry and commerce. Table II.6-A also illustrates that acreage of land differs by category between A and B. Table II.8 gives a more detailed distribution of land by scenario and economic sectors.

The six scenarios range from minimizing the effects of land use change in agriculture to providing a more favorable climate for industrial development. However, for all six scenarios it was assumed that the total number of industries would remain the same and the sum of commercial, tourist, and personal service establishments would be the same. The mix of agricultural support and other industries and the mix among commercial, tourist, and personal service establishments would vary among the scenarios.

In order to estimate the economic impacts of alternative land uses in the year 2010, the relationship of each sector gross regional income to land allocated for each of these sectors had to be determined. Ratios relating land required per $1000 of income by sector were derived. In order to do this, it was necessary to know the number of economic units by sector, income by sector, and the total land area for that sector. All economic units in the county by each sector had been identified and counted as outlined in Appendix H. Aggregation of these units resulted in 11 economic sectors. See Appendix J.

TABLE II.6 - CURRENT AND PROJECTED LAND COVER

Item	Acres			
	1978 Present Status	2010 Predicted Future	2010 Scenario A	2010 Scenario B
I. Land Cover 1/				
A. Residential (unwooded)	38,300	+14,400	+ 8,400	+19,200
B. Commercial	5,000	+ 1,920	+ 1,120	+ 2,560
C. Industrial	5,400	+ 2,880	+ 1,680	+ 3,840
D. Institutional	4,400	+ 2,400	+ 1,400	+ 3,200
E. Utilities	5,300	+ 960	+ 560	+ 1,280
F. Other Urban	4,100	(projected	by specific	category)
G. Public Parks 2/ 3/	8,900	+ 1,440	+ 840	+ 1,920
H. Woodland 3/	99,100			
1. Residential 4/	12,400	+ 8,000	+12,000	+ 4,000
2. Forest	75,400	- 8,000	-12,000	- 4,000
3. Forest Related	11,300			
I. Brush 5/	6,200	0	0	0
J. Agricultural land	424,500	-24,000	-14,000	-32,000
K. Wetlands 6/	500	0	0	0
L. Other	2,100	0	0	0
M. Total Land	603,800	0	0	0
N. Total Water 7/	20,800			
O. Grand Total	624,600			

1/ Area in public road rights-of-way not estimated separately; this causes categories shown below to be overestimated approximately in proportion to their area.

2/ Urban and rural publicly owned park land, include State owned game lands.

3/ Approximately 75,400 acres of woodland defined as commercial forest land by the U. S. Forest Service's Forest Survey are distributed between these categories.

4/ Woodland used jointly for residential purposes was estimated independently. Aerial photo interpretation, which provided the basis for land cover data, did not reflect this coincident use of woodland.

5/ Brush was defined as less than 20% woody cover.

6/ Less than 100 acres of forested wetland is included in this category.

7/ Includes approximately 1,600 acres of interior water area in addition to water area of the Susquehanna River within the Lancaster County jurisdiction.

TABLE II.6-A - RELATIONSHIP OF MAJOR COMPONENTS FORMING THE BASIS FOR SEVEN FUTURE SCENARIOS

Efficiency of Land Use		Economic Structure (Types of Firms)	
Name	Description	Name (Emphasis)	Description
Predicted future	Of the total acreage (40,000 acres) for new urban development, 8,000 acres will be satisfied by intensified development of existing urban areas and buildings. The remaining need for urban development will be satisfied by the conversion of 8,000 acres of woodland and 24,000 acres of farmland	Predicted future	Acreage of land by economic category for future scenarios determined through projections of historic trends. Acreage required per firm based on historic trends.
A (More efficient)	Of the total acreage needed (40,000 acres) for new urban development, greater emphasis will be placed on the concentration of urban uses in existing urban areas; this will satisfy the need for 14,000 acres of new development. The remaining need for urban development will be satisfied by the conversion of 12,000 acres of woodland and 14,000 acres of farmland.	Urban	More industrial development and less tourist related and agricultural related development. Less acreage required per firm than predicted future or B.
		Intermediate	Equal emphasis on both industrial and agricultural development. Less acreage required per firm than predicted future or B.
		Agriculture	Future county development encourages less general industrial development and more agricultural related industry, agricultural activities and tourism. Less acreage required per firm than predicted future or B.
B (Less efficient)	Of the total acreage needed (40,000 acres) for new urban development, less emphasis will be placed on the concentration of urban uses in existing urban areas; this will satisfy only 4,000 acres of new development. The remaining need for urban development will be satisfied by conversion of 4,000 acres of woodland and 32,000 acres of farmland.	Urban	More industrial development and less tourist related and agricultural related development. About same acreage required per firm as predicted future.
		Intermediate	Equal emphasis on both industrial and agricultural development. About same acreage required per firm as predicted future.
		Agriculture	Future county development encourages agricultural related industry, tourism and agricultural activities and less general industry. About same acreage required per firm as predicted future.

TABLE 11.6-B LANCASTER COUNTY LAND ALLOCATION BY SCENARIO AND THREE ECONOMIC LAND USE CATEGORIES FOR 2010

ITEM	PREDICTED FUTURE	SCENARIO "A"			SCENARIO "B"		
		URBAN	INTERMEDIATE	AGRICULTURAL	URBAN	INTERMEDIATE	AGRICULTURAL
AGR-RELATED INDUSTRY	2,127	1,427	1,777	2,127	1,427	1,777	2,127
OTHER INDUSTRY	5,370	5,650	5,300	4,950	7,810	7,460	7,110
TOTAL INDUSTRY	7,497	7,077	7,077	7,077	9,237	9,237	9,237
WHOLESALE-RETAIL	6,339	5,339	4,839	4,559	6,239	5,399	4,899
TOURIST	2,673	1,773	1,993	2,173	1,973	2,473	2,673
OTHER SERVICES	3,590	3,110	3,390	3,490	3,450	3,790	4,090
TOTAL COMMERCIAL	12,602	10,222	10,222	10,222	11,662	11,662	11,662
ALL OTHER LAND	583,701	586,501	586,501	586,501	582,901	582,901	582,901
TOTAL LAND AREA	603,800	603,800	603,800	603,800	603,800	603,800	603,800

Further aggregation of land area was required to relate the 12 classifications of land use with the 11 economic sectors. A simple average of acres used by firm for each sector was first determined for each classification of land. For example, the industrial land use classification identified 5,400 acres of land being used for industrial purposes, Figure II.1. However, in the economic sectors, it was desirable to separate out the agricultural related industries and all other industries. Therefore, the 677 industries in the county were first divided into the total acreage classified as industrial. The average acreage per industry of 7.98 acres was then determined. The total number of industries in the agricultural related sectors of 179 were then multiplied by the average acreage to determine the 1,427 acres in the agricultural related industries. A similar procedure was then used to subdivide the 9,100 acres in commercial and other mixed land into three general economic sectors of 4439, 1673, and 2990 acres pertaining to wholesale, retail and banking, tourist related services, and personal services, respectively. A total of 4780 firms were allocated with 2331, 878, and 1571 firms being allocated to the above-mentioned sectors, respectively, Table II.7.

Additional assumptions were made to determine total acres in households. From the land cover files of the storage and retrieval system, it had been determined that approximately 12,400 acres of land classified as forest land were in households. Therefore, the 38,300 acres of residential land were combined with the 20,000 acres of farmstead land from agriculture and the 12,400 acres of forest land in houses to form the household sector. The household sector consisted of 130,000 units. It was then possible to divide income by sector into acres per sector and obtain the acres or portion of an acre required to generate a $1000 of gross income for each sector. See Appendix J.

Table II.8 illustrates the different mixes of residential, commercial, industrial, and agricultural land which were assumed for the different scenarios. The total acreage for commercial use and industrial use for alternatives A and B of each future preference were the same, further assumptions were made about the commercial mix and industrial mix to reflect either industrial preference or agricultural preference. It was assumed that if urban development had their preferences, more industry would be developed which would be unrelated to agriculture. Also, it was assumed that less tourist related services would be developed. For the intermediate emphasis, it was assumed that a balance between banking, tourism, and personal services would be obtained. However, if agricultural land use had its preferences first, more agricultural related industries would be developed and more tourist related and personal services would be developed. For simplicity, it was assumed that the same number of industries existed under alternatives A and B for each of the three future preferences, Table II.7. Therefore, the only differences between alternatives A and B for each of these would be in the amount of land required to generate a $1000 of income by each economic sector, (land use efficiency). 1/

1/ Except for farming, productivity in all other sectors would remain at the level obtained in 1978.

TABLE II.7 - ESTIMATED TOTAL NUMBER OF FIRMS BY SECTOR FOR FUTURE SCENARIOS

	Present 1978	Pred. Future	Year 2010					
			Urban A	Urban B	Inter A	Inter B	Agr A	Agr B
1. Agriculture	4,915	4,623	4,745	4,526	4,745	4,526	4,745	4,526
2. Forestry related	85	73	70	70	75	75	78	78
3. Ag. related industry	179	267	179	179	223	223	267	267
4. Mining, construction	876	876	876	876	876	876	876	876
5. Industry	498	673	979	979	935	935	891	891
6. Transport, utilities	217	299	269	269	269	269	269	269
7. Wholesale, Retail, Banking	2,331	3,329	3,277	3,277	2,836	2,836	2,573	2,573
8. Tourist related	878	1,404	1,036	1,036	1,299	1,299	1,404	1,404
9. Other Services	1,571	1,886	1,812	1,812	1,991	1,991	2,148	2,148
10. Government related	N/A							
11. Households	130,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000

TABLE II.8 - LANCASTER COUNTY LAND ALLOCATION IN ACRES BY ECONOMIC SECTOR FOR FUTURE SCENARIOS

Economic Sectors	Present 1978	Pred. Future	Year 2010					
			Urban A	Urban B	Inter A	Inter B	Agr A	Agr B
1. Agriculture	404,500	380,500	390,500	372,500	390,500	372,500	390,500	372,500
2. Forestry related	86,700	78,700	74,700	82,700	74,700	82,700	74,700	82,700
3. Ag. related industry	1,427	2,127	1,427	1,427	1,777	1,777	2,127	2,127
4. Mining, construction	2,101	2,101	2,101	2,101	2,101	2,101	2,101	2,101
5. Industry	3,970	5,370	5,650	7,810	5,300	7,460	4,950	7,110
6. Transport, utilities	5,300	7,300	5,860	6,580	5,860	6,580	5,860	6,580
7. Wholesale, Retail, Banking	4,439	6,339	5,339	6,239	4,839	5,399	4,559	4,899
8. Tourist related	1,673	2,673	1,773	1,973	1,993	2,473	2,173	2,673
9. Other Services	2,990	3,590	3,110	3,450	3,390	3,790	3,490	4,090
10. Government related	20,000	21,700	22,240	25,120	22,240	25,120	22,240	25,120
11. Households	70,700	93,400	91,100	93,900	91,100	93,900	91,100	93,900
TOTAL	603,800	603,800	603,800	603,800	603,800	603,800	603,800	603,800

For agriculture, the average number of farms for alternative A would be different from alternative B but remain constant between the three future preferences. The number of animal units would approximately double between 1978 and the year 2010. Between the different scenarios in the year 2010, variation in animal units would be in the range of about 30 percent. Urban preference would reflect fewer animal units than intermediate and intermediate would have fewer than the agricultural preference, Table II.9.

Conservation Treatments by Scenario

1. Cropland Soil Erosion

At present (1978), approximately 87,000 acres or 24 percent of the available cropland in the county is adequately treated and needs no new conservation practices. Enough conservation practices are applied each year in the county to treat about 2,000 acres. By the year 2010, if all factors remained constant, an additional 64,000 acres of cropland would be treated making a grand total of 151,000 acres adequately treated in the county.

However, under the predicted future, there is a projected loss of 14,000 acres of cropland. Half of this loss is assumed to be treated land. Therefore, a net loss of 7,000 acres of treated land is anticipated. Subtracting this loss from 151,000 acres would leave a total of 144,000 acres, or 41 percent of the available cropland, adequately treated. With 41 percent of the cropland treated, a conservative estimate of average soil loss per acre would be around 7 tons. Given present national priorities, financial commitments to conservation, and present technology, soil erosion is not expected to decline much below this level.

To reduce soil erosion to tolerance levels ("T") in the county with existing erosion control techniques would require massive inputs of financial and technical assistance. For example, in the predicted future scenario, 110,000 acres are in need of treatment with structural practices 1/. The average cost estimated by experience in the Lancaster Field Office, SCS, is $240.00 per treated acre. Treating this 110,000 acres, at present, would require approximately $26 million.

Conservation tillage 2/ is increasing in the county and may be practiced on as much as 80 percent of the acreage by the year 2010. While conservation tillage is a good erosion control practice, most landowners are adopting it primarily because of the convenience and economy it offers. Emphasizing the importance of these factors should help sell it as an erosion control practice. Conservation tillage alone will only control soil erosion on approximately 40 percent of the land. (Soil Capability Classes I and II).

1/ Structural practices include terraces, diversions, waterways, contour stripcropping, etc.

2/ Conservation tillage includes tillage forms such as no-till, zero-till, chisel plowing, disking, minimum till, etc.

TABLE II.9 - FARM LIVESTOCK NUMBERS, CROPLAND ACRES, AND ACRES REQUIRING CONSERVATION PRACTICES 1978 AND 2010

Item	Units Year	Present Status 1978	Predicted Future 2010	2010 Urban Emphasis A	2010 Urban Emphasis B	2010 Intermediate Emphasis A	2010 Intermediate Emphasis B	2010 Agricultural Emphasis A	2010 Agricultural Emphasis B
1. Farm Livestock									
A. Cattle and Calves		237	330	314	323	347	363	380	396
1. Dairy	(1000 animals)	82	120	114	118	126	132	138	144
2. Other	(1000 animals)	155	210	200	205	221	231	242	252
B. Swine	(1000 animals)	257	500	475	490	525	550	575	600
C. Poultry	(1000 animals)								
Broilers (sales)	(1000)	36,000	60,000	57,000	56,000	63,000	66,000	69,000	72,000
Layers (inventory)	(1000)	7,300	14,000	13,300	13,700	14,700	15,400	16,000	16,800
II. Cropland									
A. Acres 1/		362,000	348,000	349,000	335,000	358,000	341,000	360,000	357,000
B. Conservation Treatment Needed	(Acres)	275,000	204,000	204,500	197,500	209,000	200,500	210,000	208,500
C. Conservation Practices Needed	(Acres)								
1. Conservation Tillage		110,000	81,600	61,400	59,300	83,600	80,200	105,000	104,300
2. Structural Practices		110,000	81,600	102,200	98,700	83,600	80,200	63,000	62,500
3. Combined Practices		55,000	40,800	40,900	39,500	41,800	40,100	42,000	41,700
D. Gross Erosion	(1000 tons)	3,330	2,436	Increase	Increase	No change	No change	Decrease	Decrease
III. Animal Manure									
A. Annual Production	(1000 tons/yr)	4,075	5,684	5,400	5,570	5,968	6,252	6,537	6,821
B. Annual Nutrient Load									
1. Nitrogen	(1000 lbs/yr)	40,750	56,840	54,000	55,700	59,680	62,524	65,366	68,208
2. Phosphorous	(1000 lbs/yr)	20,375	28,420	27,000	27,850	29,840	31,262	32,683	34,104
3. Potassium	(1000 lbs/yr)	40,750	56,840	54,000	55,700	59,680	62,524	65,366	68,208
C. Disposal Ratios (average)	tons/acre)	11.2	16.3	15.5	16.6	16.7	18.3	18.2	19.1

1/ Based on 1978 Census of Agriculture

Soil erosion on the other 40 percent of the acreage can be controlled by structural practices. The remaining 20 percent will need a combination of structural practices and conservation tillage to meet "T." These percentages will change under an urban scenario. If urban uses have their choice, they will take more Class I and II land. Given their choice, agriculture will keep more Class I and II land. The average soil loss per acre will go up under an urban scenario and down under an agricultural one. How much is difficult to predict at this time.

2. Animal Manures

An increase in animal numbers plus a diminishing supply of cropland upon which to make use of the manures produced indicate a possible future conflict. Increased spreading rates will surely result in odor and/or runoff complaints. Enough manure is produced now to cover each cropland acre with approximately 11.2 tons. This is expected to rise in the future to a high of 16.6 tons/acre under an urban emphasis on land allocation. These high rates will provide an excess of plant nutrients for growing crops, possibly resulting in depressed crop yields when the soil becomes supersaturated. Compounding this problem is the excessive use of commercial fertilizers.

It is imperative that this problem be dealt with in the future. Possibly some of the manure could be processed into a salable product and marketed. Landowners will have to monitor manure applications and reduce their consumption of commercial plant nutrients. Greater care must be exercised in the spreading of manure on the land. Both the rate and time of application will become more critical as our population of animals and people grows.

F. EVALUATION OF SCENARIOS

The Task Force evaluation has produced an estimate of one pattern of future land use as its consequence for the best agricultural areas. The impacts of several land use scenarios were also evaluated by estimating county income by economic sector resulting from projected changes in land use acreage which had been allocated to these economic sectors.

Location of Land Use Change Through Task Force Scores - One Example

Using weighted preferences developed in Task Force discussions, the agricultural land of the county was evaluated from the individual perspective of four major uses (residential, industrial, commercial, and agricultural). These independent evaluations produced a numerical score of the relative merit, on a countywide basis, of each 10-acre parcel 1/ for each major land use. The scores were computed with the convention that parcels having higher scores are more favorable places for that particular land use activity. Based on these scores, the relative quality of land for each of the three urban uses (residential, industrial, and commercial) was located on maps, Figure II.2 (A-C).

By bringing the urban uses together on a single map, a future land use distribution was produced. In a simple attempt to recognize the fact that urban uses also compete with one another, they were assigned in a specific order with industrial use given highest preference and residential use lowest preference. Since only agricultural land is under evaluation, the resulting map shows where agricultural land may be lost, Figure II.3

Do the losses of agricultural land shown in Figure 3 represent a conflict in land use? The answer to this question depends on both the location of these losses and on the quality of the land that is lost. Approximately 270,000 acres have been selected as an appropriate threshhold for defining the location of the best agricultural land, according to the Task Force evaluation scores (Figure II.4). If the areas defined as the county's best agricultural land are among those in which the evaluation anticipates future urbanization, this coincidence can be considered a form of land use conflict (Figure II.5).

These maps demonstrate, under the assumptions embodied in the Task Force evaluation, that major urban uses are attracted primarily to the area surrounding the urban core of the county (Lancaster City) and secondarily, to satellite urban centers or along major transportation arteries. Efforts to protect agricultural areas should not ignore development patterns which favor efficient urbanization. Concentrated urban development may consume some agricultural land of high quality but become less disruptive to efficient agricultural operations than more scattered urban growth. Scattered urban development, even if it were to occur on a poorer class of agricultural land, could consume more land, create a greater burden for public services, and be more disruptive to farming.

1/ The information retrieval system was developed for a data base which stores maps as a collection of 4 hectare (approximately 10 acres) square cells (or parcels) for the entire area of Lancaster County.

Figure II.2A
DISTRIBUTION OF EVALUATION
SCORES FOR URBAN LAND USES
(RESIDENTIAL)

LEGEND

.. Fair
++ Good
OO Better
■■ Best

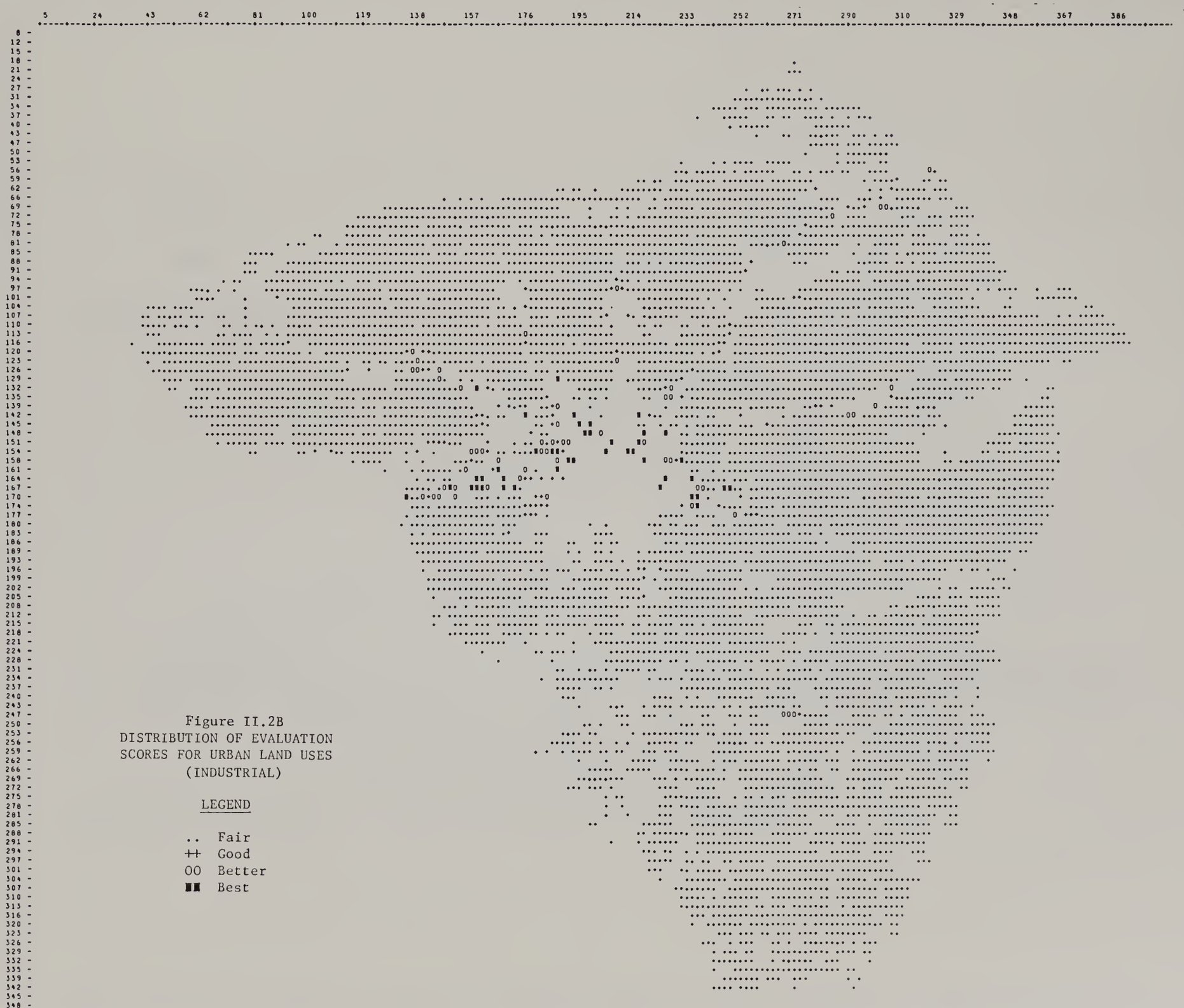


Figure II.2B
DISTRIBUTION OF EVALUATION
SCORES FOR URBAN LAND USES
(INDUSTRIAL)

LEGEND

.. Fair
++ Good
OO Better
■■ Best

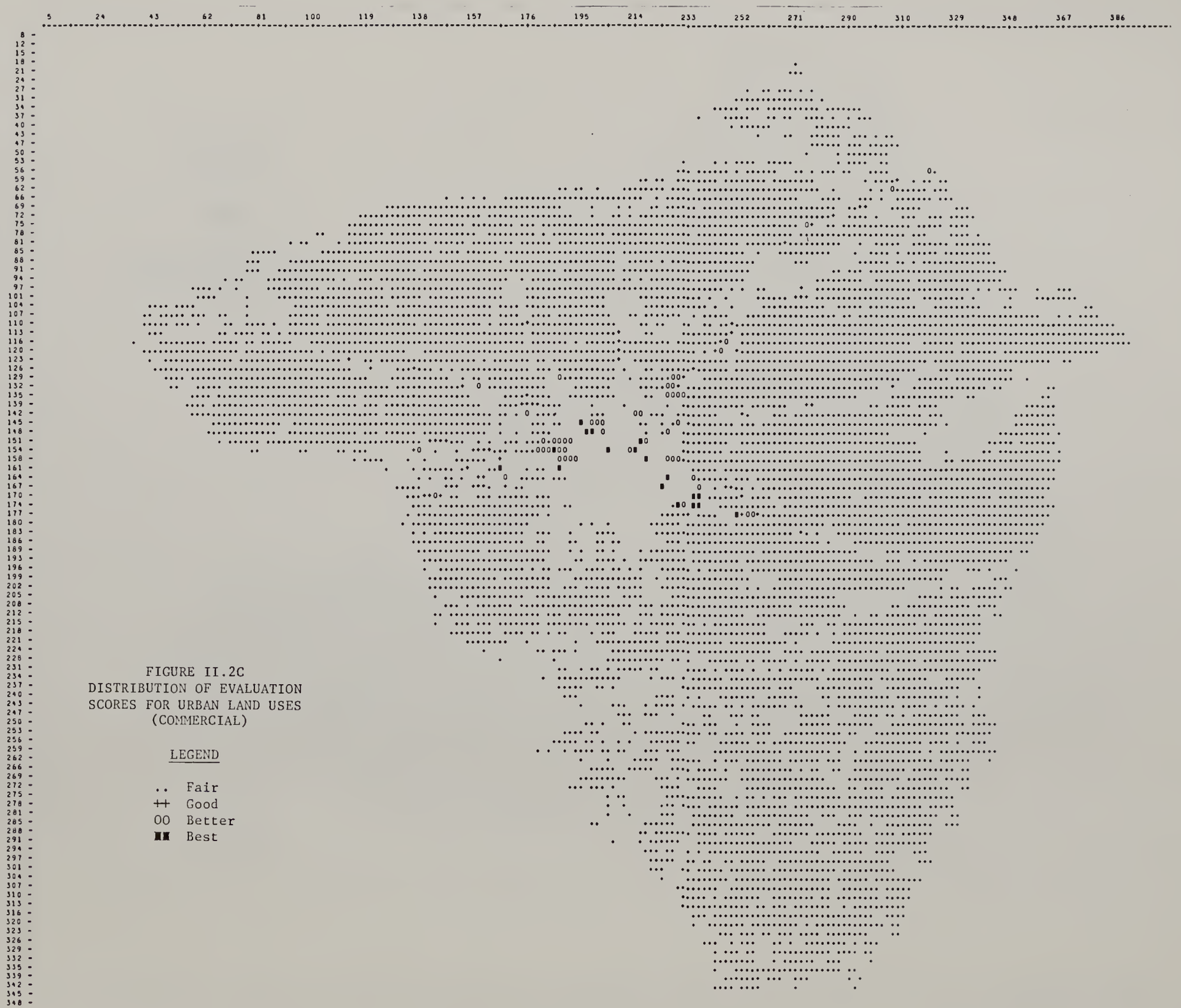


FIGURE II.2C
DISTRIBUTION OF EVALUATION
SCORES FOR URBAN LAND USES
(COMMERCIAL)

LEGEND

.. Fair
++ Good
OO Better
■■ Best

Figure II.3
POSSIBLE DISTRIBUTION OF FUTURE
LAND USES

LEGEND

.. Land Remaining in Agriculture
++ Converted to Residential Use
00 Converted to Commercial Use
■■ Converted to Industrial Use

Figure II.4
DISTRIBUTION OF EVALUATION SCORES
FOR AGRICULTURAL USE

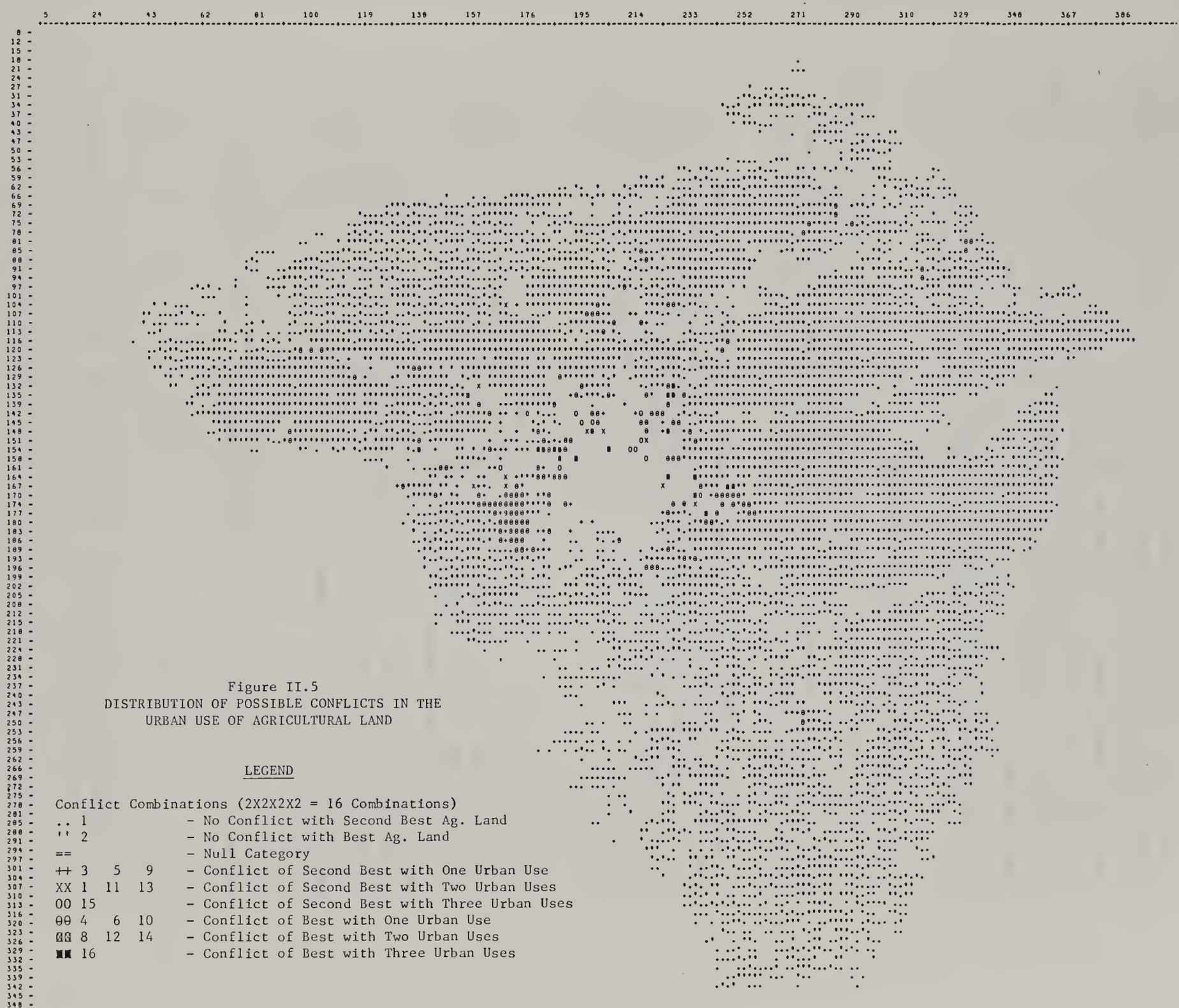


Figure II.5
DISTRIBUTION OF POSSIBLE CONFLICTS IN THE
URBAN USE OF AGRICULTURAL LAND

LEGEND

Conflict Combinations (2X2X2X2 = 16 Combinations)

..	1			- No Conflict with Second Best Ag. Land
''	2			- No Conflict with Best Ag. Land
==				- Null Category
++	3	5	9	- Conflict of Second Best with One Urban Use
XX	1	11	13	- Conflict of Second Best with Two Urban Uses
00	15			- Conflict of Second Best with Three Urban Uses
ΘΘ	4	6	10	- Conflict of Best with One Urban Use
▩▩	8	12	14	- Conflict of Best with Two Urban Uses
▮▮	16			- Conflict of Best with Three Urban Uses

In many cases, the changes suggested by these maps may not occur, simply because local municipalities have already acted to prevent the conversion of agricultural land. 1/ If loss of agricultural land in specific localities seems probable, the value of techniques to divert development from these vital areas can be examined and discussed with township officials. Where to direct this development can be explored by examining the individual urban use evaluations and by continuing to compare the resulting patterns of future urbanization with the pattern of qualitative differences for agricultural land use. In this way, both the need to preserve agricultural land of better quality, as well as the need to encourage an efficient arrangement of future urban uses, can be pursued.

Economic Impacts of the Seven Scenarios

The assumptions and predictions outlined earlier in this chapter provided the means to allocate land use by economic sectors. These projections and assumptions have been used in several efficient computer programs to determine the direct and indirect impacts on county income for each of the seven scenarios. 2/

Table II.10 contains gross income by sector for 1978 and the seven scenarios. For each of the scenarios, the assumed acreage of land by sector restricted the level of gross income by sector. Also, the above-mentioned average acreage per firm for each scenario and sector restricted the number of firms by sector. The gross county income for 1978 was discussed earlier; however, income by sector for 1978 is also included in Table II.10.

The predicted future scenario generated approximately $14.9 billion in gross regional income. For the other six future scenarios, gross regional income varied from a high of $15.8 billion where industry had first preference on land use to $15.1 billion where agriculture had first preference on land use. Since land use efficiency is basically the only difference between scenarios A and B for the future preference of industrial, intermediate, and agricultural, respectively, changes in gross county income are directly dependent upon agriculture between scenarios A and B for each preference. Agricultural income, on the other hand, varies between scenarios and future preferences. The variation in agricultural income is dependent upon the value and number of livestock which were predicted for each scenario (Table II.9).

Except for the predicted future, income in the remaining sectors was assumed to be constant in each of the scenarios.

1/ Agricultural zoning was not included in the agriculture evaluation presented here.

2/ In any analysis, assumptions are made which are based on the most reliable basis of facts and data available.

TABLE II.10 - LANCASTER COUNTY GROSS INCOME BY ECONOMIC SECTOR FOR FUTURE SCENARIOS 1/
($1,000,000)

	Present 1978	Pred. Future	Year 2010					
			Urban A	Urban B	Inter A	Inter B	Agr A	Agr B
1. Agriculture	$ 406	625	595	607	655	680	715	741
2. Forestry related	14	13	12	12	12	12	12	12
3. Ag. related industry	946	1,410	946	946	1,178	1,178	1,410	1,410
4. Mining, construction	577	577	577	577	577	577	577	577
5. Industry	2,054	2,780	4,038	4,038	3,857	3,857	3,676	3,676
6. Transport, utilities	530	730	658	658	658	658	658	658
7. Wholesale, Retail, Banking	2,625	3,749	3,690	3,690	3,193	3,193	2,897	2,897
8. Tourist related	159	254	188	188	235	235	254	254
9. Other Services	632	759	729	729	801	801	865	865
10. Government related	905	982	1,072	1,072	1,072	1,072	1,072	1,072
11. Households	2,270	2,999	2,970	2,970	2,970	2,970	2,970	2,970
Total	11,118	14,878	15,475	15,847	15,208	15,233	15,106	15,132

1/ Income measured in 1978 dollars.

The value of gross income in the agricultural related industrial sector and the other industrial sector was the same between scenarios A and B for each of the three land use preferences but income varied between preferences. Since the total number of industries was the same for the total of the two sectors (1158), income by industrial sector varied according to the number of industries in the agricultural related sector and the other industrial sector. As stated earlier in this paper, it was assumed that when agricultural preference for land use had first choice, more agricultural related industry and less other type industry would be developed. Therefore, returns in the agricultural related sector were greater when agriculture had preference for land use than when industry had first preference.

In a similar manner, when industrial development had first preference, more nonagricultural related firms and less agricultural related firms were used. The difference in income in the agricultural related and other industrial sectors reflect these assumptions, Table II-10.

The total number of firms for commercial, tourist, and service sectors for scenarios A and B of each future preference were the same; however, further assumptions were made about the commercial mix to reflect either industrial preference or agricultural preference. It was assumed that if urban development had their preferences, less tourist related services would be developed. For the intermediate emphasis, it was assumed that a balance between banking, tourism, and personal services would be obtained. However, if agricultural land use had its preferences first, less wholesale, retail, and banking services and more tourist related and personal services would be developed.

Income for each of these preferences indicates these assumptions as illustrated in Table II-10.

The new gross sector income for each sector was used to restructure the original money flow table. A computer program was used to rebalance the money flow table so that income equalled expenditures for each sector for each scenario. A total of seven new 11 by 11 sector money flow tables were developed. Information from each of these balanced tables was used with computer programs to (1) obtain information on the direct and indirect impacts each scenario had on county income, and (2) compare the impacts of the various scenarios. See Appendix J for more information.

For all projected scenarios, it was assumed that the ratio of all exports to gross regional income would increase from about 50 percent in 1978 to 60 percent in 2010. This predicted increase in exports reflects increased production by the increased number of firms in the county. However, it was assumed that agricultural exports would increase from about 20 percent in 1978 to 60 percent in 2010. The overall result of this assumption caused the multipliers in all sectors to be less than their counterpart in 1978. 1/

1/ Each sector multiplier determines the amount of economic activity generated in the county per additional export dollar of production in any sector.

The information in Tables II.11 and II.12 can be used to determine the direct and indirect impacts on county income for the different scenarios. Table II.11 lists the sector trade multipliers obtained from the solutions of the input-output program and Table II.12 lists the value of exports for each sector and scenario.

For example, the direct and indirect response by the whole county for agricultural exports of $335 million for the predicted future scenario would be about $760 million (agricultural's sector trade multiplier of 2.27 multiplied by its export value of $335 million). Although the projected multiplier of 2.27 for agriculture is less than the 1978 multiplier of 2.74, the volume of economic activity generated throughout the county increased from $207 to $760 million.

The additional money generated resulted from the increased ratio of exports to gross income in agriculture and some minor restructuring of the relationships within and among the various sectors.

Another example illustrates the industrial sector's total contribution to county economic activity for the urban scenario A. The total county response for industrial export value of $3,614 million is $5,972 million--industry's sector trade multiplier of 1.65 multiplied by its value of exports of $3,614 million. In a similar manner, agricultural contribution to county income is its sector trade multiplier of 2.30 multiplied by its export value of $333 million or $766 million.

For the urban scenario A, agricultural contribution to county economic activity of $766 million is approximately the same as its contribution of $760 in the predicted future scenario. On the other hand, industry's contribution of $5,972 million is $1,796 million more than its contribution in the predicted future of $4,176 million. Similar comparisons can be made within and among sectors for the various scenarios.

As can be noted after reviewing the sector trade multipliers in Table II.11, relatively minor changes resulted in the value of the multipliers for any given sector among the scenarios; however, the monetary impact on the county economy could be affected to a greater extent as illustrated in the above examples.

TABLE II.11 - SECTOR TRADE MULTIPLIERS REQUIRED TO SUPPORT A $1.00 VALUE OF EXPORTS BY ECONOMIC SECTOR IN LANCASTER COUNTY

	Present 1978	Pred. Future	Year 2010					
			Urban A	Urban B	Inter A	Inter B	Agr A	Agr B
1. Agriculture	2.7439	2.2698	2.2966	2.2967	2.2696	2.2660	2.2647	2.2656
2. Forestry related	3.2350	2.7076	2.7485	2.7478	2.7143	2.7091	2.7012	2.7011
3. Ag. related industry	2.4765	1.9479	1.9799	1.9799	1.9460	1.9419	1.9363	1.9373
4. Mining, construction	2.5847	2.2126	2.2395	2.2402	2.2208	2.2191	2.2180	2.2198
5. Industry	1.9578	1.6511	1.6524	1.6530	1.6370	1.6356	1.6340	1.6353
6. Transport, utilities	1.6254	1.3817	1.3672	1.3675	1.3648	1.3638	1.3712	1.3721
7. Wholesale, Retail, Banking	1.6474	1.3993	1.3978	1.3981	1.3856	1.3845	1.3844	1.3853
8. Tourist related	2.7153	2.3831	2.3760	2.3765	2.3651	2.3634	2.3668	2.3681
9. Other Services	1.7149	1.4633	1.4622	1.4626	1.4371	1.4360	1.4278	1.4286
10. Government related	2.0512	1.6973	1.6936	1.6941	1.6806	1.6792	1.6804	1.6817
11. Households	2.0432	1.6998	1.6848	1.6853	1.6820	1.6804	1.6874	1.6887

TABLE II.12 - VALUE OF EXPORTS BY ECONOMIC SECTOR REQUIRED TO DELIVER COUNTY INCOME BY SECTOR IN LANCASTER COUNTY FOR THE VARIOUS SCENARIOS
($1,000,000)

	Present 1978	Pred. Future	Year 2010					
			Urban A	Urban B	Inter A	Inter B	Agr A	Agr B
1. Agriculture	76	335	333	344	374	399	412	436
2. Forestry related	1	1	1	1	1	1	1	1
3. Ag. related industry	700	1,136	764	763	945	943	1,118	1,115
4. Mining, construction	330	398	386	385	388	388	387	386
5. Industry	1,770	2,529	3,614	3,612	3,454	3,452	3,288	3,284
6. Transport, utilities	248	430	377	377	375	375	370	369
7. Wholesale, Retail, Banking	1,234	2,176	2,058	2,054	1,768	1,764	1,584	1,576
8. Tourist related	27	63	43	43	55	55	59	58
9. Other Services	138	237	210	209	232	232	249	248
10. Government related	586	734	776	776	778	777	775	773
11. Households	444	860	737	736	755	755	757	754
TOTAL	5,554	8,999	9,300	9,299	9,125	9,140	8,999	9,000

G. BRIEF REVIEW OF SCENARIO PROCEDURES AND RESULTS

The procedures or tools developed and used to evaluate possible future scenarios can and should be used by local interest groups to develop new, or update current, data files for the Geographic Information System (GIS). The county currently has the tools via the GIS to determine locations of potential land use conflicts in the county for many different uses. The Task Force on land use has determined land use preferences and the values of the weighted criteria. The Task Force or any interest group can establish different weighted criteria and determine other conflict areas via the GIS system.

Information from Appendix J can be utilized to estimate economic impacts of different land uses; however, the economic models used to estimate county income and total monetary impacts on county income from the seven scenarios are not currently part of the county computer system.

As stated earlier in this chapter, page II-7, projected population was assumed to be one of the most important socioeconomic factors in projecting future land uses and acreage left in agriculture. In this chapter, procedures were used to evaluate the results of assumptions based on one population projection. Appendix J, in addition to the population projected in this chapter, evaluated the results of two alternative population projections (1.1 and 1.8 million people by the year 2010). Local interest groups can and could use the procedures outlined in this chapter to also evaluate the conflicts in land uses for different projected populations and land use preference.

CHAPTER III

CHAPTER III - PLANNING IMPLICATIONS

A. INTRODUCTION

The intent of this study was to provide analytical methods to assist in making decisions about Lancaster County's future development. The study has not identified a preferred scenario, nor developed a program for implementing any of the scenarios. Selecting and implementing a preferred scenario continues to be the responsibility of the study's local sponsors and other concerned Lancaster County residents. The analytical methods and study results should remain useful in further refining the components of a preferred scenario and in developing a program of implementation.

The purpose of this chapter is to examine policies and programs which are relevant to each of the scenarios. Policies and programs related to the efficiency of land utilization are discussed first. This is followed by a discussion of policies and programs relevant to the economic composition of the county. The chapter concludes by discussing the roles that can be taken by various agencies and organizations to address the other problems and concerns of the study.

Determining programs and policies which could produce a future similar to a particular scenario requires a close examination of the assumptions used in developing the scenarios. These assumptions are summarized in Table II.6-A and developed in detail throughout Chapter II.

B. POLICIES INFLUENCING EFFICIENCY OF LAND USE

The amount of agricultural land required for future development will depend on how efficiently land is utilized. The study explored the effects of both a more efficient and a less efficient utilization of land for each economic scenario. Under the more efficient option, new urban development needs will be satisfied by the conversion of 14,000 acres of farmland, 12,000 acres of woodland, and intensification of development within urban areas. The less efficient option requires 32,000 acres of farmland and 4,000 acres of woodland to satisfy new development needs.

Local policies and programs can influence the efficiency of land use in a variety of ways. All agencies and organizations involved in the development of Lancaster County could follow a policy of favoring concentrated development on land other than prime agricultural land. Such policies could complement current trends, such as an interest in conserving energy or providing affordable housing, which stimulate more intense, concentrated development of land.

Foresight and planning can result in more intensified and efficient growth by limiting the amount of land available for development. Municipal governments with undeveloped or underdeveloped land can create programs, such as restrictive agricultural and open space zoning, which limit the amount of new development allowed in these areas. The County government, through programs such as the Deed Restriction Program, can

prohibit any future development of land which is enrolled in the program. Private organizations can also acquire land or the rights to develop land, thereby controlling the supply of land available for development.

Growth can be managed in ways that control the pressure to develop agricultural land. Limiting the extension of public services will encourage developers to consider sites within serviced areas. This will require the efforts of local governments and the State and Federal agencies which fund public services. Infill development, which is the development of vacant parcels surrounded by existing urbanized areas, more fully utilizes existing services and reduces the pressure to convert productive agricultural land to urban uses. Higher residential densities can be promoted both in new construction and within existing buildings. An example of this potential is the conversion of large, and often vacant, buildings into condominiums in downtown Lancaster. Each condominium apartment represents some amount of agricultural acreage that will remain in agricultural production; that is, some demand for new residential space has been satisfied by the intensified use of existing urban space. The Federal and State agencies which finance residential development could follow policies which guide development away from prime agricultural areas. Efforts to revitalize existing commercial areas, both downtown and along commercial strips, can also reduce the development pressure on undeveloped land.

C. POLICIES INFLUENCING ECONOMIC STRUCTURE

The analysis compares three economic scenarios--urban, intermediate, and agricultural. Each scenario is characterized by a different amount of economic activity and number of firms in selected sectors. The urban scenarios show the greatest amount of growth in the industrial and commercial sectors. The agricultural scenarios were developed to show the greatest amount of growth in agriculturally related industries, the tourist industry and the Service industry. The intermediate scenarios represent balanced economic growth, but differ somewhat from the predicted future. Policies and programs could be developed to promote growth in the selected economic sectors.

These scenarios were developed to display a range of economic structures for the county and to demonstrate the capabilities of the economic model. The scenarios could be redefined and the model run again to demonstrate the effects of growth in specific sectors of the economy. This could be useful in analyzing both the economic effects on specific sectors and the land use impacts of any economic development effort which concentrated on growth of selected sectors.

Urban Scenario

The urban scenario was broadly defined as a climate more favorable to industrial development. In the economic analysis, agriculturally related industry, tourism, and other services have been allocated less land than in the other scenarios. Other industry and wholesale-retail sectors have been allocated more land in the urban scenarios than in the other scenarios.

Local interests could promote the urban scenario by means that emphasize nonagricultural commercial and industrial development. An economic development program targeted at these economic sectors could be developed by both the private and public interests at the local level.

Local planning and zoning programs could emphasize the identification of prime commercial and industrial sites. Programs could be developed to afford added protection for these sites or to offer incentives for their development.

Intermediate Scenario

The strength of Lancaster County's economy is due to its diversity; many sectors are strong. Local policies in the past have not concentrated on the development of one sector over another. Several new sectors, most notably tourism, have been introduced into the economy in recent years, with the guidance of interest groups, and have thrived. The intermediate scenario exemplifies continuance of this diversity, with no major sector being developed disproportionately.

Agricultural Scenario

In the agricultural scenario, more land is allocated to agriculturally related industries, tourist related businesses, and personal services than under the other scenarios. Other industry and the wholesale-retail sector are allocated less land than under the other scenarios.

Local policies could support this scenario by adopting programs that develop and promote Lancaster County's agricultural economy, tourism resources, and service industries. The policies would concentrate on these sectors and minimize development and promotion of nonagricultural industry and the wholesale-retail sector.

Under this scenario, local interests should identify resources important to tourism and develop programs to protect and develop those resources. Programs could be developed to make Lancaster County an attractive site for service industries.

D. POLICIES AND RULES OF FEDERAL, STATE AND LOCAL AGENCIES AND ORGANIZATIONS

The only identifiable concern that can be addressed directly by the USDA agencies involved is the one of soil erosion. The bulk of the assistance needed to address this problem would have to come from two Federal agencies, The Soil Conservation Service and the Agricultural Stabilization and Conservation Service. Some technical assistance would be needed from the Forest Service and a limited amount of financial assistance could be channeled through the Farmers Home Administration. In addition, educational assistance would be needed from the Extension Service.

A number of Federal, State and local agencies and organizations offer programs that impact upon the Problems and Concerns outlined in Chapter I. The programs of these agencies are briefly summarized below.

FEDERAL AGENCIES

There are six U. S. Department of Agriculture agencies and one U. S. Department of the Interior agency available that have programs that could be useful in addressing the problems and concerns of Chapter I.

Soil Conservation Service

The Soil Conservation Service (SCS) has a broad program of soil and water conservation and development. Their principal function is to assist landowners and operators in the planning of land use and the installation of land treatment measures. SCS also provides technical and financial assistance to State and local organizations for watershed protection, flood prevention, fish and wildlife enhancement and public recreation.

The Soil and Water Resources Conservation Act of 1977 authorized SCS, in cooperation with citizen groups, conservation districts, and other Federal, State, and local agencies, to appraise the soil, water, and related resources of the Nation and to develop a soil and water conservation program based on the appraisal.

In addition, SCS provides information and data on soil, land use, and the magnitude of problems within the county. The Soil Survey Program and the Inventory and Monitoring Program have historical and current data available upon request from State and local agencies.

Forest Service

The Forest Service (FS) is divided into three principal branches: the National Forest System, State and Private Forestry, and Forest Research. Only the State and Private Forestry branch are represented in the county.

This arm of the Forest Service has responsibility for providing national leadership, and technical and financial assistance to resource managers and operators of non-Federal forest lands. The Forest Service, through Pennsylvania's Department of Environmental Resources, Bureau of Forestry, provides leadership in the protection and management of Lancaster County's privately owned non-industrial forest lands. Cooperative forestry programs, administered through the above authority, include management planning, timber production, insect and disease control, control of rural fires, improvement and maintenance of fish and wildlife habitat, and urban forestry assistance. Forest industries may receive assistance in forest products utilization, marketing, and management.

Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service (ASCS) administers production adjustment, resource protection, and farm income stabilization programs. The ASCS provides cost sharing for a wide variety of soil, water, forestry and related conservation and/or pollution abatement practices. They can provide cost sharing for agricultural damages or losses caused by natural disasters.

ASCS also administers the Conestoga Headwaters Rural Clean Water Program (RCWP) in Lancaster County. This is a long-term water quality improvement program, covering 110,000 acres, that provides technical and financial assistance to owners and operators of rural land to help control nonpoint sources of water pollution. SCS helps the participants prepare and apply water quality plans.

Farmers Home Administration (FHA)

This agency makes loans and grants to qualified recipients. Loans are available for farm ownership and operations, emergencies, recreational enterprises, grazing associations, and conservation practices. Loans are also available to small communities for water and waste disposal systems. In addition to finacial aid, the Farmers Home Administration provides technical and management assistance.

Economic Research Service

The Economic Research Service (ERS) develops and administers programs of economic research, analysis, and information related to national food and agriculture, natural resources, and rural communities. State and local governments, individuals, organizations, and communities may find the information of interest and useful for resolving their problems.

Extension Service

The Cooperative Extension Service (CES) acts as the education agency of the USDA and the land grant universities. Extension specialists work with other agencies to provide information to local people relating to the soil and water conservation programs. Three levels of government--Federal, State, and county--share in financing, planning, and carrying out extension education programs.

Geological Survey

The U. S. Geological Survey (USGS) is an agency of the Department of the Interior. They prepare geologic maps, appraise mineral resources, and carry on research in the principals and instrumentation of geology, geophysics, and geochemistry. This work is performed in cooperative projects and the information produced provides the physical basis for the effective planning of programs for development of natural resources and the efficient operation of interrelated projects at Federal, State, and local levels.

The USGS also operates gaging stations for measurement of streamflow and observation wells for recording changes in ground water storage. Typical projects carried out by this agency are either hydrologic data collection or aerial studies such as the quantity and quality of water resources of a county or river basin.

The USGS just completed the Pequea Creek Study in the county and is participating in the water quality monitoring portion of the Rural Clean Water Program underway in the county.

STATE AGENCIES

The Department of Agriculture, Environmental Resources, and Community Affairs are the three State agencies that offer programs to address or minimize the problems and concerns outlined in Chapter I.

Department of Agriculture

This agency operates three programs that could be useful in addressing problems and concerns. The Clean and Green Act provides for the preferential tax assessment of farmland, forest land, and agricultural reserve land. The purpose of the Act is to encourage the retention of land in agricultural production.

The Federal Assistance Program Retrieval System (FAPRS) is a program that provides a free and convenient way of locating Federal funding programs for rural communities.

The Sewer and Water Line Assessment Exemption Program exempts agricultural production land from the payment of assessments for sewer and water lines.

Department of Environmental Resources

This agency offers a number of technical and financial assistance programs that can be used by study sponsors. Programs available are: Flood Control Assistance, Erosion and Sediment Control Assistance, Forestry Advisory Services, and Forest Pest Management. In addition, programs dealing with the Clean Streams Law, Water Supplies, Water Conservation, Environmental Planning, Water Pollution Control, and Recreation are available.

Department of Community Affairs

Some of the programs available through this department deal with flood insurance, flood plain redevelopment, flood damage mitigation, comprehensive planning, community facilities, and land and water conservation.

COUNTY AND LOCAL AGENCIES

The principal agencies and/or organizations having responsibility for administering programs and providing services to promote the conservation and utilization of land and water resources are the Lancaster County Planning Commission, the Lancaster County Conservation District, the Agricultural Preserve Board, and the Lancaster Chamber of Commerce and Industry.

Lancaster County Planning Commission

This county agency is responsible for assisting local municipalities in developing and implementing plans as well as reviewing local planning efforts. Areas of specialization include zoning, areawide review, and intergovernmental coordination.

Expertise is also available in areas such as transportation, recreation, housing, the environment, utilities, population, and energy for countywide projects and activities.

The Planning Commission also has the responsibility for reviewing subdivision and land development proposals within the county.

Lancaster Conservation District

The Lancaster Conservation District is responsible for conservation work within the county.

The district acts as a liaison among the various Federal, State, county, and local agencies concerned with the preservation of natural resources including agricultural land, open spaces, water quality and quantity, pollution, environmental relationships, and aesthetic values. The conservation district promotes soil and water conservation practices such as conservation tillage and proper animal waste management.

In Lancaster County, the conservation district administers the erosion and sedimentation control program for the Pennsylvania Department of Environmental Resources. In this regard, they receive complaints, assess the problems in the field, and work with the landowner and/or earthmover to stimulate voluntary compliance.

The district is also the local sponsor for several special programs and studies taking place within the county.

Agricultural Preserve Board

The Board, appointed by the Lancaster County Commissioners, administers a deed restriction program to preserve agricultural land in the county.

The Agricultural Preserve Board encourages the insertion of restrictions into deeds so that farmland can be preserved wholly for agricultural use. Donated deed restrictions will be encouraged anywhere in the county; deed restrictions for which some kind of payment is required will be sought in agricultural preserves.

The Agricultural Preserve Board's activities will include development of sample deed restrictions, delineation of agricultural preserves, education of the general public, and potential participants about the deed restriction program, assistance to farmland owners who wish to apply deed restrictions to their properties, and preparation of recommendations for improved enabling legislation for the deed restriction program.

Lancaster Chamber of Commerce and Industry

The Lancaster Chamber of Commerce and Industry directly supports developmental activities designed to maintain a balanced level of economic and land use diversity in the county. Land use planning, as supported by the Chamber, produces recommendations that must be implemented through joint public and private efforts. The Chamber encourages decisions that will preserve adequate farmland and agricultural productivity to maintain an economically viable agricultural community. At the same time, they support the immediate identification of nonprime agricultural areas as locations for the county's needed growth.

CHAPTER IV

CHAPTER IV - RESOURCE BASE

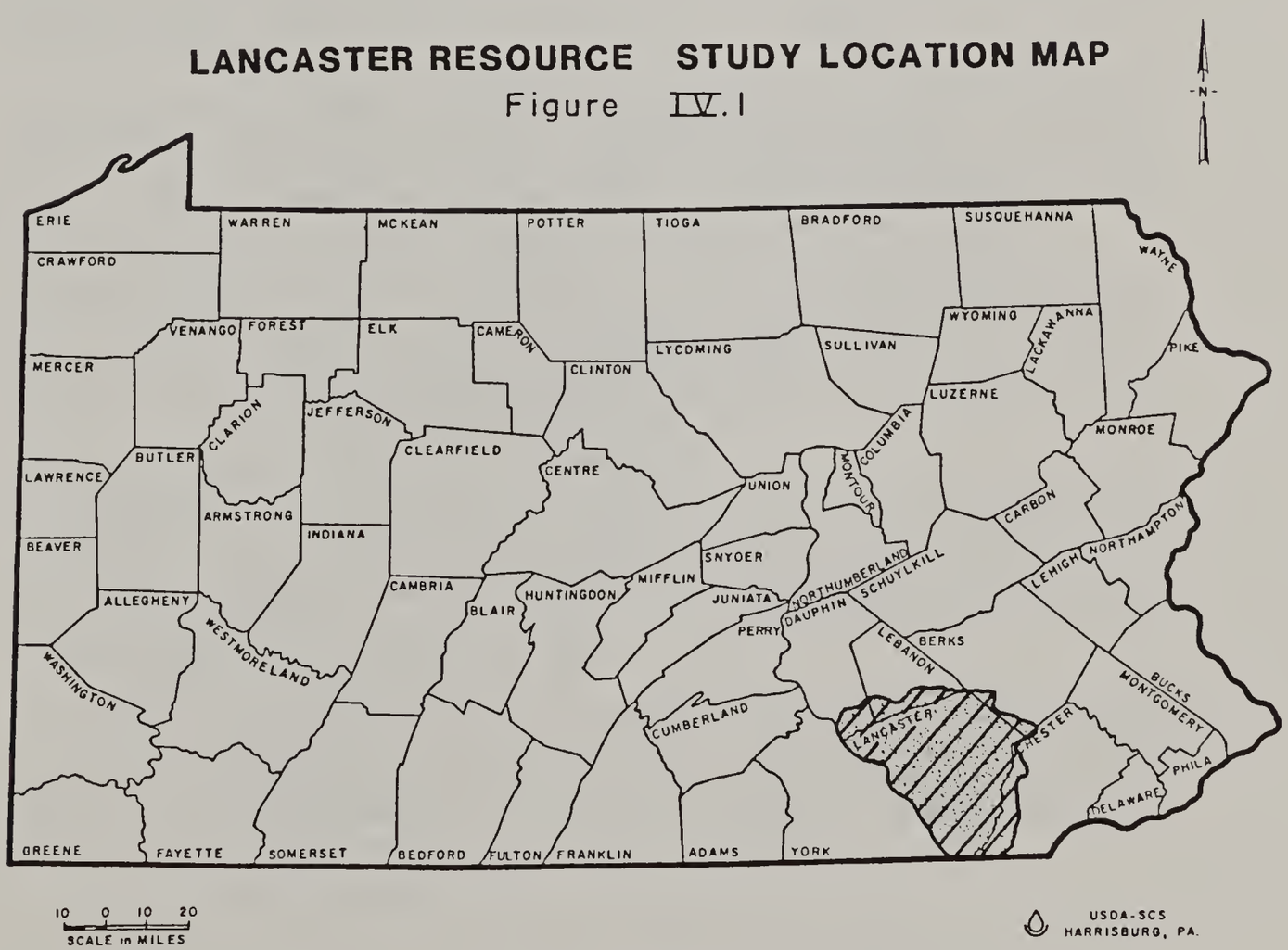
A. LOCATION

Lancaster County is located in the southeastern part of Pennsylvania and is situated along the western fringe of the eastern seaboard megalopolis between Philadelphia and Baltimore (see Figure IV.1). With a land area of 943.4 square miles, or 603,800 acres, Lancaster County is the 12th largest of the 67 counties in Pennsylvania. The county includes 20,800 acres of water, primarily contained within the Susquehanna River.

The easternmost edge of the county lies within 15 to 20 miles of the Philadelphia and Wilmington urbanized areas. Four other urban concentrations are located within 10 miles of the Lancaster County boundary. These areas are Reading to the northeast, Lebanon to the north, Harrisburg to the northwest, and York to the west. The Susquehanna River flows in a southeasterly direction, along the western boundary of the county, for a distance of more than 40 miles. The political divisions which border Lancaster County are Chester County to the east, Berks, Lebanon, and Dauphin Counties to the north, York County to the west, and the State of Maryland to the south.

LANCASTER RESOURCE STUDY LOCATION MAP

Figure IV.1



B. WATERSHEDS

Lancaster County is comprised of 12 major watersheds, 11 of which drain into the Susquehanna River. The 12th watershed comprises the headwaters of the Brandywine Creek in northeast Lancaster County. This watershed eventually drains into the Delaware River (see Figure IV.2).

Six major drainage areas are within the remaining 11 watersheds of the county. Chickies Creek drains the northwestern portion, the Conestoga River drains the northeastern to southcentral portion, and Pequea, Conowingo, and Octoraro Creeks drain the eastern and southern portion of the county. All these streams flow in a southwesterly direction before merging with the Susquehanna River.

WATERSHEDS

Lancaster County, Pennsylvania

Figure IV.2

C. GEOLOGY

Most of the rocks underlying the county had their origin 600 to 400 million years ago. Some Precambrian crystalline rocks, more than 600 million years old, do occur.

Horizontal layers of sand, gravel, silt, and limy materials were deposited in a sea that covered the area. Repeated deposition and consolidation formed the sediments into rock strata. Near the end of the Paleozoic Era, 230 million years ago, uplifting and folding forces from the southeast raised the rock strata above sea level. The formations were folded, faulted, and tilted by lateral uplifting and folding forces. Intrusion of molten volcanic materials and uplifting and folding recrystallized some sedimentary and igneous rocks into metamorphic rocks. Repeated disturbances and uplifts, along with natural erosion, exposed rocks of different ages and formed peneplanes.

Gradual uplift, along with vertical faulting in the northern part of the county, produced an elongated sunken trough. Deposition into this basin during the Triassic Period, 230 to 180 million years ago, produced the characteristic red sandstone and shales. Igneous intrusions, along with uplift, tilting, and faulting, altered these rocks. Subsequent uplift and erosion of the Lancaster County area occurred several times. The present landscape is the result of weathering action on the last of these uplifted plains.

Exposed rocks in the area were formed during the Precambrian, Cambrian, Ordovician, and Triassic Periods. The Precambrian to Lower Paleozoic rocks include schist, serpentine, quartzite, and other metamorphic and igneous rocks. Exposures of these rocks are found in the southern part of Lancaster County and the Welsh Mountains.

The upper formations of the Cambrian Period are dolomite and limestone. These rocks form a band west to east across the widest part of the county. The Antietam, Harpers, and Chickies Formations, Lower Cambrian, are phyllite, schist, and quartzite. These rocks are present in the west-central and east-central areas of the county.

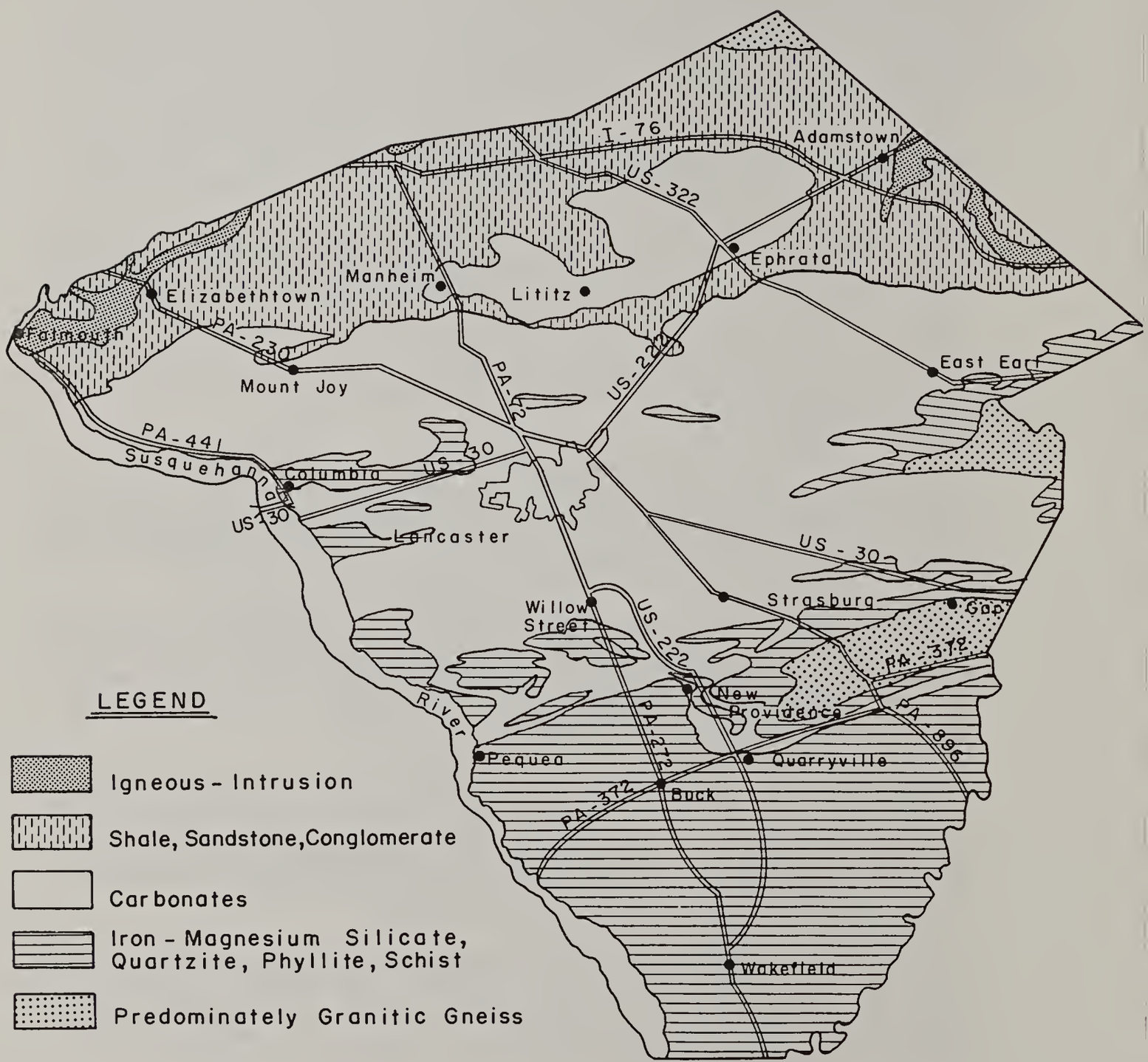
Formations of Ordovician age include the Cocalico, Conestoga, and Beekmantown. The Cocalico rocks consist of shale and are found in the northcentral part of the county. The Conestoga rocks consist of crystalline limestone and dolomite with thin graphitic and micaceous beds. The formation is present in a wedge-shaped band that narrows eastward across the central part of the county.

The Beekmantown Group consists of limestone and dolomite. They form two extensive belts north of the Cambrian rocks. The Triassic age rocks lie along the northern borders of the county. These are most red shale, sandstone, and conglomerate. Diabase is present in sheets intruded between beds of sedimentary rock.

GEOLOGY MAP

Lancaster County, Pennsylvania

Figure IV.3



0 1 2 3 4 5 6 7 8 9 10

SCALE in MILES

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

D. PHYSIOGRAPHY AND TOPOGRAPHY

Lancaster County lies in the Piedmont Physiographic Province and is divided into the following three sections:

Triassic Lowlands Section - This section lies in the extreme northern tenth of the county and is characterized by having broad ridgetops with gentle to steepsided slopes. Elevation in the Furnace Hills and Wernersville Ridge area approach 1250 feet above sea level and 275 feet at the Susquehanna River.

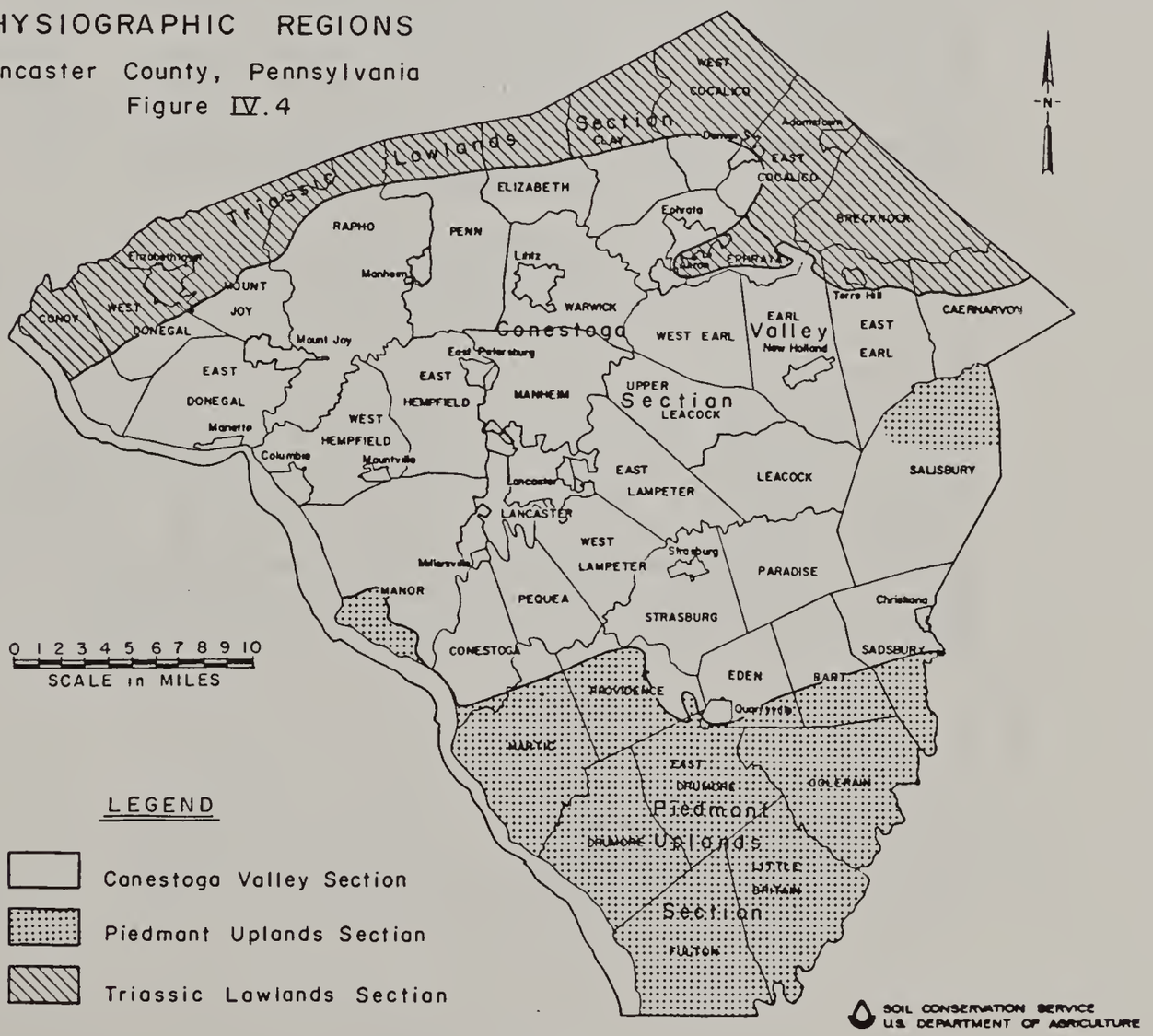
Conestoga Valley Section - This is a large section in the northern and central portion of the county. The landscape is predominately near level to gently rolling topography. Elevation ranges from 200 feet above sea level at the Susquehanna River to over 600 feet at the eastern extent.

Piedmont Uplands Section - This section lies in the southern part of the county. The topography is characterized by deep valleys and abrupt hills that have gently sloping ridge tops. Elevations range from 120 feet above sea level at the Susquehanna River to 1100 feet in the Welsh Mountain area.

PHYSIOGRAPHIC REGIONS

Lancaster County, Pennsylvania

Figure IV.4



E. CLIMATE

The climate of Lancaster County is typified by moderate changes in temperature, abundant and generally dependable precipitation, and a relative long growing season. The county is considered to have a modified continental climate with hot summer temperatures and rather cold winter temperatures. The precipitation is well distributed throughout the year.

Average monthly temperatures range from a low of approximately 29 degrees in January to a high of 74 degrees in July. The average yearly temperature is slightly above 53 degrees. The average annual precipitation is 43 inches with 56 percent or 24 inches of rain usually falling in April through September, encompassing the growing season for most crops. The average annual snowfall for Lancaster County is 27 inches.

The data presented in Table IV.1 is a compilation of average monthly temperatures and precipitation from 1951-78 at the United States Weather Service station in Ephrata, a northeastern Lancaster County community. At an elevation of 465 feet above sea level, the Ephrata station is higher than the Lancaster station in the westcentral area of the county. It is interesting to note that the average annual temperature at these two stations is about the same, but the annual precipitation and snowfall at the Ephrata station are one to two inches greater. A Weather Service station at Holtwood, because of its location along the Susquehanna River and its elevation of 187 feet, has an average annual temperature of two degrees greater than the Ephrata station. However, the annual precipitation is only approximately 36 inches.

The growing season in Lancaster County varies from 160 to 220 days, with an average of 180 days. The average date of the last frost in spring is April 30, but frost has occurred late in May. The average date of the first frost in autumn is October 7, but frost has occurred as early as late August.

The average relative humidity in Lancaster County during midafternoon is about 55 percent. However, the humidity is generally higher at night with the average at dawn being about 75 percent. The percentage of possible sunshine is 65 percent in summer and 50 percent during the winter. The prevailing winds are from the northwest. The average wind speed is highest in the spring, being approximately nine miles per hour.

Table IV.1 TEMPERATURE AND PRECIPITATION DATA, LANCASTER COUNTY

(Data was recorded in the period 1951-78 At Ephrata, Pennsylvania)

Month	Temperature			Precipitation	
	Average Daily Maximum	Average Daily Minimum	Average	AVERAGE IN.	SNOWFALL AVERAGE IN.
January	37.1	21.3	29.2	2.97	8.4
February	40.3	23.0	31.7	2.50	8.3
March	49.7	30.5	40.1	3.57	4.9
April	62.7	40.5	51.6	3.82	.1
May	72.7	49.8	61.3	3.41	.0
June	81.1	58.9	70.0	4.15	.0
July	85.0	63.2	74.1	4.17	.0
August	83.1	62.0	72.6	4.59	.0
September	76.1	55.3	65.7	3.95	.0
October	65.3	44.7	55.0	3.03	.0
November	52.1	34.9	43.5	3.43	.9
December	40.6	25.7	33.2	3.57	4.3
AVERAGE YEARLY:		TOTAL:	52.3	TOTAL: 43.16	26.9

F. SOILS

Soil is one of Lancaster County's basic and most important resources. It is also one of the most variable. Approximately 86 different soil types are in the county, each possessing an individual set of characteristics which will respond differently to the uses made of it.

Soil characteristics such as depth, drainage, parent material, slope and texture strongly influence the way we can use the land. A knowledge of these characteristics is essential to all who work with the soil if the best use is to be made of this resource.

The Soil Association Map, Figure IV.5, shows the major soil associations of the county. These associations are made up of two or three dominant soils plus other minor soils that can have strongly contrasting properties.

This map furnishes an overall picture of the soils and their distribution throughout the county. It is particularly useful for general planning. The small scale, however, limits the use for detailed planning because many inclusions of minor dissimilar soils have to be included in each association. For refined interpretations and on-site investigations, a detailed soil survey map must be used. Such maps are available at the local Soil Conservation Service field office.

There are six soil associations in Lancaster County. These associations are named for the major soils within their boundaries. These associations are as follows:

1. Manor-Chester-Glenelg Association

Gently sloping to moderately steep, well-drained soils on broad ridge-tops and side slopes, formed in residuum from mica schists, granitized schist, and gneiss.

This association occupies 31 percent of the county. The landscape consists of relatively broad gently sloping to moderately steep rolling ridges with some steep and very steep side slopes adjacent to major streams. About 32 percent of the association is Manor soils, 30 percent is Chester soils, 23 percent is Glenelg soils, and the remaining 15 percent is soils of minor extent.

Minor soils include the well-drained Lansdale soils, moderately well and somewhat poorly drained Glenville soils; and the moderately well and somewhat poorly drained Newark soils.

This association is generally in cropland and the soils are well suited for this use. Some areas are wooded or are in urban development. Slope is a limitation for nonfarm uses in some areas.

2. Duffield-Hagerstown Association

Nearly level to sloping well-drained soils in undulating broad valleys formed in residuum from limestone.

This association occupies 28 percent of the county. The landscape consists of nearly level to rolling hills of the limestone valleys dissected by drainageways. About 42 percent of the association is Duffield soils, 40 percent is Hagerstown soils, and the remaining 18 percent is soils of minor extent.

Minor soils include the well drained Manor and Chester soils; the moderately well drained Clarksburg soils; the moderately well drained Lindside soils; and the somewhat poorly drained Newark soils.

This association is predominantly in cropland. Most areas of this association are well suited for this use. Sinkholes and ground water contamination are possible hazards of these soils. Slope is a limitation for nonfarm uses in some areas.

3. Ungers-Buck-Lansdale Association

Nearly level to moderately steep, well drained soils on ridges and foot slopes, formed in residuum from triassic siltstones, conglomerates, shale, and sandstones.

This association occupies 19 percent of the county. The landscape consists of dissected rolling hills with moderately wide foot slopes. About 34 percent of the association is Ungers soils, 19 percent is Bucks soils, 13 percent is Lansdale soils, and the remaining 34 percent is soils of minor extent.

Minor soils include the well drained Brecknock soils; the moderately well drained Readington soils, and the somewhat poorly and poorly drained Bowmansville soils.

Approximately 50 percent of the area of this association is used for farming. The remaining areas are mostly wooded. Small areas are used for homesites and recreation. Slope and stoniness are the main limitations for most nonfarm use.

4. Letort-Pequea-Conestoga Association

Nearly level to sloping well drained soils on side slopes of ridges formed in residuum from micaceous limestone and graphitic phyllite and schists.

This association occupies 12 percent of the county. The landscape consists of nearly level to rolling upland valleys and ridges dissected by drainageways and, occasionally, by intrusions of mica schist. About 27 percent of the association is Letort soils; 17 percent is Pequea soils; 17 percent is Conestoga soils; and the remaining 39 percent is soils of minor extent.

Minor soils include the well drained Hollinger soils; the deep, moderately well drained and somewhat poorly drained Glenville; the deep, moderately well drained Clarksburg soils; the moderately well drained Lindside soils; and the somewhat poorly drained Newark soils.

This association is mostly in cropland and the soils are well suited for this use. Some areas are wooded or in urban use. Slope is the main limitation for most nonfarm uses.

5. Bedington Association

Nearly level to sloping, well-drained soils on dissected hills and ridges formed in residuum from yellowish brown acid shales.

This association occupies 8 percent of the county. The landscape consists of nearly smooth to rolling dissected ridges. About 75 percent of the association is Bedington soils and the remaining 25 percent is soils of minor extent.

Minor soils include the well drained Lansdale soils and the moderately well drained to somewhat poorly drained Blairton soils.

This association is mostly in cropland and is well suited for this use. Some areas are wooded or in urban uses. Slope is the main limitation for most nonfarm uses.

6. Clymer-Chester Association

Nearly level to moderately steep, well drained soils on broad ridges in residuum from sandstone, mica schists, granitized schist, and gneiss.

This association occupies 2 percent of the county. The landscape consists of nearly level ridgetops to very steep side slopes of ridges. About 64 percent of the association is Clymer, 23 percent is Chester soils, and the remaining 13 percent is soils of minor extent.

Minor soils include well drained Manor soils and the moderately well drained Glenville soils.

This association is mostly wooded; however, some areas are farmed or are in nonfarm uses. Slope and stoniness are the main limitation for nonfarm use.

CAPABILITY GROUPINGS

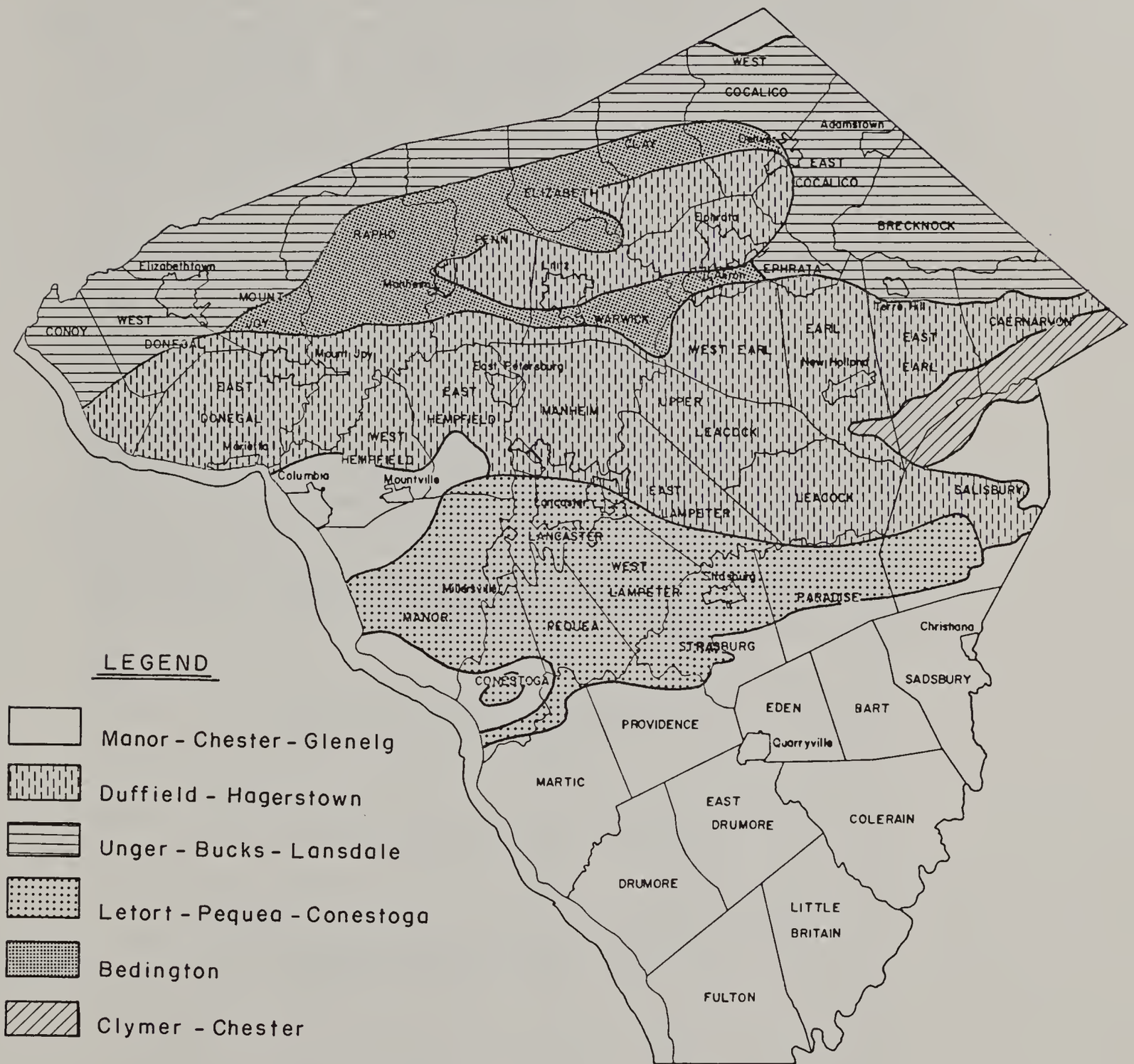
Capability grouping of soils provides information useful in the management of soils for agricultural purposes. 1/ Although familiarity with this classification will permit one to infer much about the behavior of soils when used for other purposes, these groupings are not intended to be a substitute for other suitability or limitation ratings.

1/ Please refer to the published Soil Survey Manual for a general description of capability grouping in the section titled, "Use and Management of the Soils."

SOIL ASSOCIATION MAP

Lancaster County, Pennsylvania

Figure IV.5



0 1 2 3 4 5 6 7 8 9 10

SCALE in MILES

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Because each specific soil mapping unit is assigned to a single capability grouping, the new soil survey, which has been stored in the geographic information system, can be easily translated into an agricultural capability map (Figure IV.6). In addition, this translated soil survey map can be matched to the county's land cover map, which is also available in the geographic information system. A cross-referenced tabulation of acreage, which resulted from matching these two computer files, is shown in Table IV.2. This table shows the approximate acreage of each particular capability grouping for every land cover category. Each cell of this table represents the summation of all occurrences of similar combinations of capability groups with land cover categories. However, these figures do not convey any information about the geographic location of the acres which contributed to each summation. Some may represent widely scattered areas while others may be concentrated in a few localities.

Although the maps for these two computer files were prepared independently, the agreement is quite striking. Of the 20,800 acres of water estimated from the land cover map, 19,500 acres (94%) agree with the soil survey map; other water area found assigned to various capability subclasses may be attributed to differences in map resolution or category definition. The capability grouping of urban land (first six rows) has been possible because the present soil survey is a remapping of a previously surveyed area. Therefore, acreage or urban land under defined capability groups gives a rough indication of the quality of agricultural land used for development during the period between the two surveys. Also noteworthy is nearly 25,000 acres of woodland and brush contained in capability groups I and II. However, without a map showing the location of this land, it is difficult to know if these acres are concentrated in a few localities or dispersed throughout the county. The geographic information system provides the means to clarify this aspect in the relation of these two maps.

TABLE IV.2 - DISTRIBUTION OF AGRICULTURAL SOIL CAPABILITY BY GENERAL LAND COVER CATEGORIES FOR LANCASTER COUNTY 1/

Land Cover Category	Agricultural Soil Capability Subclass - acres -										
	2/	I	IIe	IIw	IIIe	IIIw	IVe	Vw	VIs	VIIs	Total
Residential	7,000	4,100	15,000	1,300	6,000	400	2,400	0	900	1,200	38,300
Commercial	1,500	1,100	1,700	300	300	0	100	0	0	0	5,000
Industrial	2,300	1,300	1,300	200	200	0	0	0	100	0	5,400
Institutional	900	800	1,900	100	400	0	200	0	0	100	4,400
Utilities	1,000	500	1,900	100	600	200	200	0	100	700	5,300
Other Urban	700	500	1,700	200	500	100	200	0	100	100	4,100
Public Parks	500	400	1,800	200	800	100	200	0	800	4,100	8,900
Woodland	3,300	1,900	18,200	2,600	15,000	2,400	9,900	200	16,100	29,500	99,100
Brush	800	200	1,600	300	1,300	300	800	0	300	600	6,200
Cropland	2,100	41,900	194,900	18,200	63,600	5,600	22,100	800	3,700	5,400	358,300
Pastureland	800	3,500	23,100	9,000	12,200	2,900	7,000	400	800	1,700	61,400
Other Agric.	0	400	2,500	400	800	100	400	0	100	100	4,800
Wetlands	200	0	100	100	0	100	0	0	0	0	500
Water	19,500	100	400	100	200	100	200	0	100	100	20,800
Other	800	100	600	100	300	0	100	0	100	0	2,100
Total	41,400	56,800	266,700	33,200	102,200	12,300	43,800	1,400	23,200	43,600	624,600
Percent of County (%)	6.6	9.1	42.7	5.3	16.4	2.0	7.0	0.2	3.7	7.0	100.0

1/ This information is based entirely on the Geographic Information System Files for land cover and soils.

2/ No classification assigned; this column represents urbanized or disturbed areas and water.

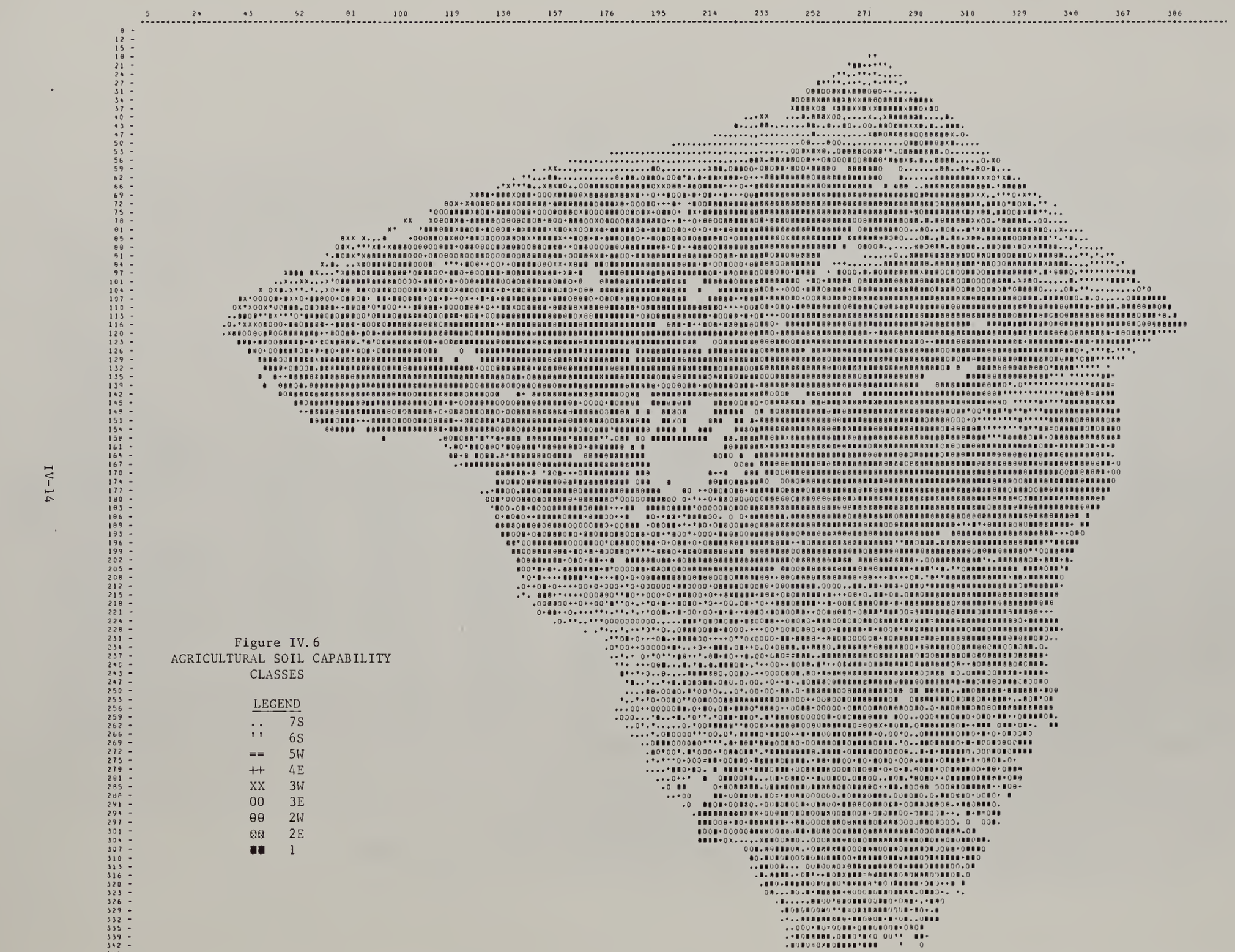


Figure IV.6
AGRICULTURAL SOIL CAPABILITY CLASSES

LEGEND	
..	7S
''	6S
==	5W
++	4E
XX	3W
00	3E
0Θ	2W
ΘΘ	2E
■■	1

G. WATER RESOURCES

Lancaster County receives an average of 43 inches of precipitation annually. This results in about 16 inches or one million acre-feet of surface water runoff. All the precipitation falls within the watershed of the Susquehanna River Basin, except for 2000 acres in the eastern portion of the county which are part of the Brandywine watershed of the Delaware River Basin.

Sources of Water

a. Surface Water. Lancaster County contains approximately 20,800 acres of water with the principal drainage area being the Susquehanna River which forms the entire western boundary of the county. Other major drainage areas are the Conestoga River and the Conewago, Conoy, Chickies, Little Conestoga, Cocalico, Mill, Pequea, Conowingo, and Octoraro Creeks.

No major natural lakes exist in Lancaster County, although there are several significant man-made lakes. Lake Clarke, Lake Aldred, and Conowingo Lake are located on the Susquehanna River and are used for power generation and recreation.

Lake Clarke, created by the Safe Harbor Dam and owned by the Safe Harbor Water Power Company, has a surface area of 7328 acres and a storage capacity of 30,000 million gallons. The Holtwood Dam, a Pennsylvania Power and Light Company facility, located seven miles south of Safe Harbor, creates Lake Aldred, a 1260-acres body of water with a storage capacity of 6,975 million gallons. The Conowingo Lake, formed by the Conowingo Dam, is located on the river six miles south of the Pennsylvania State line in Maryland. Owned by the Philadelphia Electric Company, the Conowingo Dam creates a 9,000-acres lake, over half of which is in Lancaster County.

Another facility is the Philadelphia Electric Company Muddy Run pump-storage dam adjacent to the Susquehanna River in southern Lancaster County. A 640-acres lake on the Muddy Run is used for power generation. An additional dam at the headwaters of this lake impounds another 98 acres of surface water which supplements the power facility and provides for recreational use.

The Pennsylvania Fish Commission owns the Speedwell Forge Lake in Elizabeth Township which is a 106-acres body of water used for recreation. The Middle Creek Wildlife Management Area contains over 400 acres of water. Owned by the Pennsylvania Game Commission, this facility is used for waterfowl impoundment, wildlife management, and recreation.

One major body of water, located in part within Lancaster County, is used as a municipal water supply. The Octoraro Lake, owned by the Chester Municipal Water Authority, has a surface area of 669 acres, 375 of which are within and along the southeastern boundary of the County.

b. Groundwater. The availability of groundwater in Lancaster County varies with each type of geological formation. The most productive wells are generally those which have been located to take the maximum

advantage of conditions favoring the greatest amount of accumulation and circulation of groundwater. Well yields depend primarily on the geology and topographic location. The most favorable well locations are usually in valleys, because in the flow system groundwater moves to the lower elevations.

The Triassic Lowland Section is composed of shale, sandstone, conglomerate, and igneous diabase rocks. Groundwater storage and movement is available mainly from secondary porosity (joints, faults, and bedding planes) and to some extent from primary porosity (intergranular openings). Some of the important aquifers in the section are the Gettysburg and New Oxford formations. The diabase rock has a very low porosity and is considered a poor aquifer. Except for the diabase, quantities have proven to be adequate for domestic use with the more favorable sites located in stream valleys. The water quality is generally good but is moderately hard with the presence of calcium and magnesium minerals.

The Conestoga Valley section is composed of limestone and dolomite rocks. The source of groundwater storage and movement occurs only from secondary porosity features which include joints, fractures, fault zones, and solution cavities. Due to geologic structural disturbance and weathering, these features are common. A good yielding well depends on the success of interesecting these water-bearing zones in the well. Some of the important aquifers in this section include the Conestoga limestone and Vintage and Ledger dolomites, and yields exceeding 500 gpm have been obtained in some wells. Water is very hard due to the calcium and mineral. Because of the solubility of these rocks, many of the solution cavities and sinkholes are interconnected and extend over a large area. As a result, this aids in the groundwater contamination problem to the carbonate area.

In the Piedmont section of the county, the rocks are of igneous and metamorphic origin and generally have a low groundwater storage capacity. Groundwater supplies are available from bedrock joints, cleavage and fault zones with very little, if any, storage from intergranular porosity. Although groundwater supplies are being tapped from all geologic units, the largest aquifers in this section are the Wissahickon schist and Peters Creek schist. The quality of water is generally good with low to moderate dissolved solids, soft water, and high iron content.

Quantity of Water

The quantity of water within Lancaster County is difficult to determine since several factors combine to influence the amount of water available. Forested land cover will help to retain groundwater, but at the same time the trees take water from the ground and transpire it. The gradual decline of forested acreage is making less water available by accelerating the overland flow into streams and out of the county without the opportunity to recharge the groundwater supplies.

Much of the available supply of water to Lancaster County is provided by the Susquehanna River. Since the county is located within the lower

reaches of the river basin, and the basin size upstream from the county is approximately 25,000 square miles, the quantity of water to the county is affected by the demands and consumption of upstream users.

Quality of Water

In general, Lancaster County has had adequate supplies of good quality water for agricultural, residential, commercial, and industrial uses. However, recent drought conditions, coupled with the steady growth of the county and its subsequent effect upon the demand for water, has increased the concern over the potential of surface and groundwater pollution.

Increasing amounts of treatment have been necessary in some areas to produce high quality drinking water because of decreasing stream quality. High bacteria levels and turbidity are the major surface water contaminents. Bacterial pollutants can be either fecal bacteria or bacteria associated with decaying algae from algaeal blooms caused by nutrients in sewage effluent and fertilizer runoff. Turbidity is not only a product of the erosion of soils which includes agricultural chemicals, but it also includes pollutants from urban areas. These pollutants are carried into the streams either by storm water runoff or by human negligence. Some of these pollutants, including oil, chemicals, and potentially toxic substances, cannot be easily removed by conventional water treatment methods. Oil spills usually temporarily suspend water treatment operations until the spill is cleaned up. Industrial wastes, particularly from upstream industrial areas on the Susquehanna River, have also created treatment problems.

Groundwater contamination generally occurs from livestock wastes, malfunctioning industrial and domestic waste systems, and over fertilization. In Lancaster County, the most widely dispersed and potentially dangerous source of contaimination is livestock waste. Applied to the soils in proper amounts, animal wastes can improve soil fertility and agricultural productivity. Carelessly handled, these wastes can impair yields and degrade the quality of both surface and groundwater. Nitrates, the end product of oxidation of nitrogenous matter contained in livestock waste, are highly soluble in water, and are readily leached through the soil to pollute both surface and groundwater.

In Lancaster County, the primary groundwater contamination areas lie within the limestone and dolomite formations where the solubility of these rocks and the many fractures, joints, and fault zones develop into an interconnecting network of solution cavities. These cavities act as subsurface conduits for groundwater movement. Additionally, the presence of sinkholes on the surface of this strata allows for surface water infiltration to the subsurface cavities. Sinkholes are common, unpredictable, and can occur anywhere in carbonate rocks.

H. AGRICULTURE

Lancaster County is the number one agricultural county in Pennsylvania. With products valued at $664,000,000 in 1980, agriculture is the leading economic sector in the county and employs, directly or indirectly, approximately 10 percent of the county's work force.

While agriculture is strong in the county, it is following the National trend. The number of farms and the acreage devoted to those farms is declining. At the same time, the size of the remaining farms is increasing. Statistics reflecting these changes are shown in the following table:

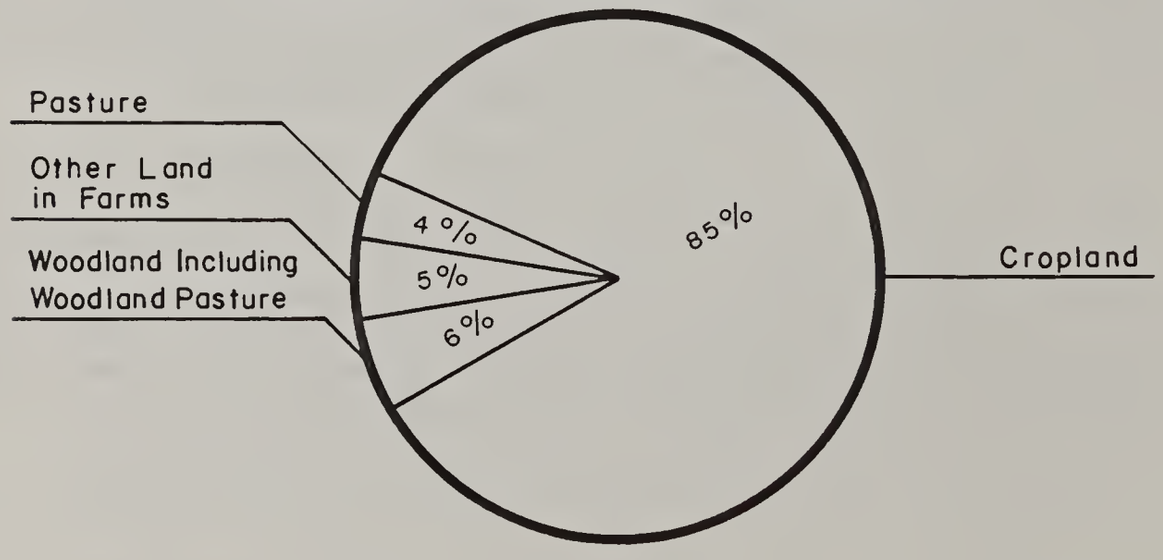
Table IV.3 - FARM STATISTICS FOR LANCASTER COUNTY

Year	Number of Farms	Acreage in Farms	Average Size of Farms Acres
1964	6,247	467,321	75
1978	4,915	424,500	87

Farming is still family oriented with 89 percent of all farms being classified as family farms. The majority are also owned by their operators. Only 18 percent are operated by tenants.

Land use in the county is continuing to shift from agriculture to urban uses, but not at the rapid pace that took place during the early 1970's. The bulk of the county's 603,800 land acres is still used for agricultural purposes. Agricultural land use is shown by the following figure:

Figure IV.6A - Agricultural Land Use



Source: 1978 Census of Agriculture, U. S. Department of Commerce, Bureau of the Census.

Rich, productive soils, abundant rainfall, a moderate climate, and a long growing season contribute to the success of agricultural productivity in the county. The proximity to major east coast markets further intensifies the importance of Lancaster County as a major source of agricultural products.

In 1980, Lancaster County ranked first in Pennsylvania in five of six livestock categories and in five of eleven crop categories. The county also contributes a significant percentage to Pennsylvania's gross produce value in a number of agricultural categories.

Despite the outstanding status of Lancaster County as a leading agricultural producer, it is not without its problems. Perhaps the most serious threat is the continued loss of good farmland to development. While agriculture is located throughout the county, it is the area within a 12-mile radius of the City of Lancaster that is the most productive, having both the best soils and the least amount of slope. Unfortunately, this area has also been subject to the pressures of much of the county's commercial, industrial, and residential suburban expansion. This development has resulted in the loss of some high quality agricultural lands. However, the acreage of cropland 1/ in the county has actually increased from 327,000 acres in 1974 to 362,000 acres in 1978.

This apparent inconsistency in the data is due in part to the replacement of agricultural lands lost to development with lands taken out of pasture or recently cleared and put into production and also to definition changes from one census period to another. For the most part, new lands put into agricultural production cannot match the capability of the soils which are lost to development and which are within 12 miles of the City of Lancaster. Soils outside this region, in the northern part of the county, are shallow and not as productive, while southern Lancaster County is characterized by rolling hills and deep stream valleys.

1/ 1978 Census of Agriculture, U. S. Department of Commerce, Bureau of the Census.

TABLE IV.4 - PERCENTAGE OF GROSS PRODUCE VALUE IN PENNSYLVANIA LANCASTER COUNTY -- 1981

Industry	Percentage
Field and Forage	12.0
Wheat	12.7
All Corn	13.7
Dairy	14.1
All Livestock	14.5
Hogs	34.1
Broilers	37.7
Poultry and Eggs	40.3
All Chickens	48.0
Layers	48.3
Tobacco	92.3

To perpetuate the agricultural industry of Lancaster County as a major sector of the county's economy, the preservation of agricultural lands has become an issue of prime importance. As of October 1982, 20 of the 40 agricultural townships within Lancaster County had adopted agricultural zoning districts in efforts to limit development and to preserve the county's prime agricultural soils, its cultural heritage, and its standing as an important sector of the economy. An additional 10 municipalities are undertaking agricultural zoning studies and it is anticipated that by early 1983, four more municipalities will have adopted exclusive agricultural district zoning ordinance provisions.

It should be noted that while agricultural zoning is an effective tool in the effort to preserve agricultural land, it can be viewed as a temporary one since zoning regulations can be changed. Another approach was initiated by the Lancaster County Board of Commissioners in 1980 when it appointed an Agricultural Preserve Board to investigate more long-term preservation methods. This Board has recently established a deed restriction program for Lancaster County whereby farm owners and the county become parties to deed restrictions which limit land to an agricultural use either for a specified period of time or in perpetuity.

I. POPULATION

The census of 1980 indicates that the population of Lancaster County is 362,346. This figure represents a 13.2 percent increase over the 1970 count of 320,079 and 30.2 percent above the 1960 level of 278,359. The 13.2 and 30.2 percent growth rates exceeded the 0.5 and 4.8 percent rates for Pennsylvania during the same periods.

The population increase of 42,000 persons from 1970 to 1980 makes Lancaster County the second fastest growing county in Pennsylvania. Only Bucks County, which is located adjacent to and north of Philadelphia, showed a greater population increase with nearly 58,000 persons. Lancaster County is now the sixth most populous county in the State.

In 1980, 54.6 percent of the county population lived within areas classified as urban by the U. S. Bureau of the Census; only a 0.4 percent increase since 1970. This region comprises the City of Lancaster, the closely settled and developed areas immediately surrounding the city, including five boroughs, and an additional seven boroughs which are outside the urbanized area. These areas are identified by the map in Figure IV.7. The data provided in Table IV.6 indicates the trends from 1970 to 1980 for urban and rural population and land areas. While the percentages of total rural and urban population have not significantly changed during this period, nearly 31 square miles of rural land in 1970 is classified as urban land in 1980. Despite the losses of rural land from 1970 to 1980, Lancaster County ranks first in Pennsylvania with a rural population of 164,580 persons.

In 1980, the county contained 129,368 dwelling units with an average of 2.8 persons per dwelling. Statistics from 1970 indicated 3.17 persons per unit, and in 1960, 3.3 persons lived in each county residence. These figures show the marked decrease which is consistent with the State and National trend toward smaller households. The number of persons per dwelling in Lancaster County is slightly higher than the State norm. Pennsylvania figures for the same categories are 2.57 in 1980, 3.0 persons in 1970, and 3.16 persons in 1960.

Lancaster County has gained housing units faster than it has gained in population. The number of housing units increased from 100,771 in 1970 to 129,368 units in 1980. The percentage of increase in the number of housing units in the 1970's more than doubled the percentage of population increase (28.4 percent vs. 13.2 percent).

The median family income in Lancaster county for 1979 was $20,569, which is above the State median of $19,995. The county ranks 15th in order of median income in the State. Four of the five Pennsylvania counties adjacent to Lancaster County have higher median income levels, with only the level for Lebanon County being lower than this figure.

URBANIZED AREAS

Lancaster County, Pennsylvania

Figure IV.7

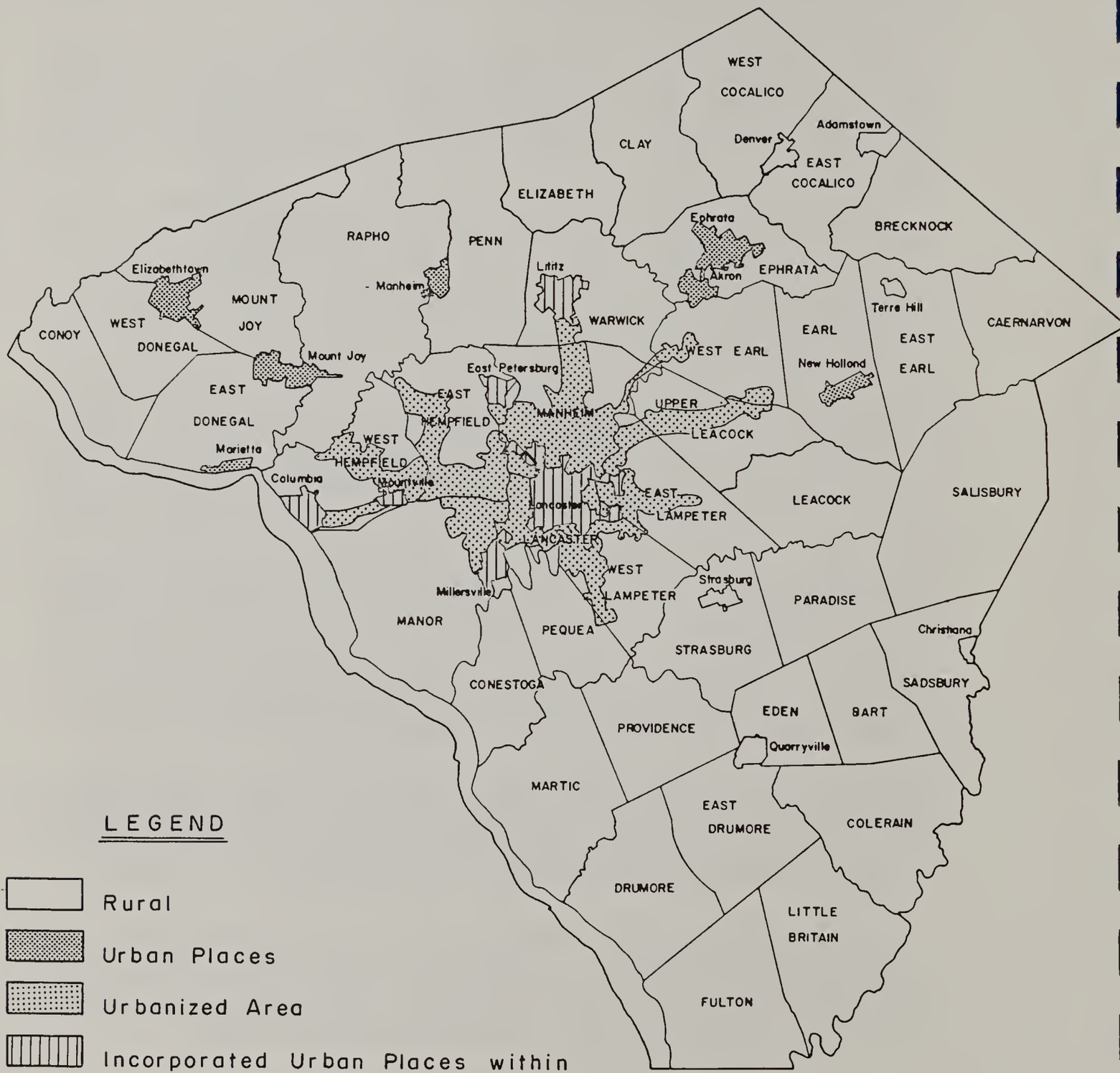


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TABLE IV.5 - URBAN AND RURAL POPULATION
LANCASTER COUNTY

	1980		1970	
	Number	Percent	Number	Percent
Total Population	362,346	100.0	320,079	100.0
Total Urban 1/	197,766	54.6	173,573	54.2
Urbanized Area 2/	157,385	43.4	117,097	36.6
Other Urban Places 3/	40,381	11.2	56,476	17.6
Rural	164,580	45.4	146,506	45.8

	1980		1970	
	Square Miles	Percent	Square Miles	Percent
Total Land Area	943.4	100.0	943.4	100.0
Total Urban	74.5	7.9	44.3	4.7
Urbanized Area	62.3	6.6	28.3	3.0
Other Urban	12.2	1.3	16.0	1.7
Rural	868.9	92.1	899.1	95.3

1/ Urban population comprises all persons living in urbanized areas and incorporated urban places (boroughs) of 2,500 or more persons outside of urbanized areas.

2/ The urbanized area consists of the City of Lancaster and the surrounding closely settled territory (See Figure IV.7).

3/ Other urban consists of all incorporated places (boroughs) of 2,500 or more persons outside the urbanized area (See Figure IV.6 for urban places).

J. FISH AND WILDLIFE

The transition of Lancaster County from its original forest cover to the mixture of agricultural and urban land uses of today has caused a significant change in the animal population of the county. The destruction of hedgerows, fence rows, and the draining and clearing of odd areas, as well as the removal of crop residue after harvest, has reduced winter food and cover for wildlife. Additionally, the sub-urbanization of the City of Lancaster, combined with steady growth throughout Lancaster County, has removed acres of vegetative cover.

A number of the 40 mammal species which were identified as original inhabitants of Lancaster County no longer exist in the region. These animals include the bison, elk, timber wolf, cougar, bobcat, and Delmarva fox squirrel. The Norway rat, house mouse, and red fox are introduced species inhabiting the county today.

Over 100,000 acres of State Game Lands and the Farm Game Projects are being managed for wildlife by the Pennsylvania Game Commission. The Pennsylvania Game Commission's efforts to establish a quality of wildlife cover in the county have produced some of the best small game hunting lands in eastern Pennsylvania. All species of game presently found in the Commonwealth, with the exception of elk, have been sighted in Lancaster County.

Land use changes, the removal of vegetation, and the subsequent adverse effect upon stream water quality have seriously affected the fish population of many county streams. Siltation, industrial and municipal wastewater discharges, dams, and increasing water temperatures have acted to reduce the numbers of fish, while less desirable species of fish have become dominant. See Appendix F, Fish and Wildlife Resources Report, for more detailed description of indigenous species in the county.

However, several streams in southern Lancaster County remain of high quality and can support trout propagation. An additional 22 streams are stocked with trout annually by the Pennsylvania Fish Commission. The Pennsylvania Fish Commission also operates the Speedwell Forge Lake, stocking it with largemouth bass and several other species. The Susquehanna River provides a variety of habitats and, therefore, a variety of game fish, including channel catfish, muskellunge, walleye, Northern pike, rock bass, smallmouth bass, crappie, and red-breasted sunfish.

K. FOREST LAND

Prior to the arrival of the first settlers, most of Lancaster County was in forest. As the land was settled, stands of trees were removed and the soils were cultivated. The high fertility of the county's soils attracted more and more rural settlement until all of the original forest land was depleted.

Today, Lancaster County has approximately 99,100 acres of second- and third-growth forest cover which amounts to over 16 percent of the county's land area.1/ Approximately 91 percent of this acreage is privately owned, while nine percent is under public ownership.

The larger tracts of forest land lie on the slopes and summits of the uplands located along the northern section of the county and on the rolling hills of the Welsh Mountains. Another belt of forest land extends along the Susquehanna River, south of the mouth of the Conestoga River. Much of the southern portions of the county contain concentrations of forest land in stream valleys and on rolling hillsides. Isolated patches of wooded areas occur among the farmlands and on creek bottom flood plains of the Lancaster Plain (see Figure IV.8).

The forest lands of the county are mainly deciduous hardwoods of the oak-hickory forest cover type; however, the composition of the forests vary with local drainage characteristics and the relative fertility of the soils.

Ninety-five percent of the forest land in the county is on soils having very high, high, and moderately high productivity. The remaining five percent is on soils that have moderate productivity.

Well drained and fertile or moderately fertile wooded soils contain mixtures of white, black, and red oaks, and some red maple, hickory, white ash, and yellow poplar. Infertile but well drained forested soils on ridges or higher slopes support stands of primarily scarlet oak and black oak with some hickory, pine, ash, chestnut, and white oak. Rocky, shallow, and dry soils on upland locations support woodlands of mostly chestnut and scarlet oak, with some white pine.

A number of smaller trees will grow under the cover of the aforementioned forest growth. This includes dogwood, sassafras, black gum, and blue beech. Where fields near the forest areas have been abandoned, the land is gradually reclaimed by such trees as white ash, Eastern red cedar, black locust, and yellow poplar.

It is difficult to assess an accurate figure for the volume or value of forest land timbered in Lancaster County because a significant percentage of cuttings are processed and used by individual landowners. Commercially classified forest land (96,100 acres), however, presently has sawtimber on 71 percent of the acreage, poletimber on 15 percent, with the remaining 14 percent comprising seedling and sapling stands and stands of less than 10 percent growing stock trees.

1/ The forest land acreage will be coordinated with the National Resource Inventory (NRI) land use figures during final review of the NRI data.

In assessing the future of forest land in Lancaster County, it is probable that the wooded acreage will continue to decline because of the expansion of residential development and changing landowner patterns. Home builders and home buyers are finding it desirable to move on to the steeper, forested areas of the county. While these areas are still classified as forest land, they are used as other than a source for forest products, including wildlife habitat, recreation, aesthetics, and privacy or buffer zones around homes. Nearly 24,000 acres of forest land have been utilized to some degree by urban development in forested areas.

Changing landowner patterns, particularly in the central and southern sections of Lancaster County, have resulted in continued losses of forest land acreage. Areas presently in trees are being converted to cropland as the demand for additional row cropping acreage increases. However, many forested areas are either too steep or too stony to be economically converted into cropland use.

LANCASTER AREA
LAND AND WATER RESOURCES STUDY

FOREST LAND LOCATION

Figure IV.8

LEGEND

- ■ ■ FOREST
- O O STATE PARKS & GAME LANDS
- θ θ SCRUB BRUSH (LESS THAN 20% WOODY COVER)

15,000 0 15,000
SCALE IN FEET

L. AUTOMATED RESOURCE INFORMATION SYSTEM

One of the important phases of the Lancaster Area Land and Water Resources Study was the development of a computerized information retrieval system. This system, known as the Geographic Information System (GIS), consists of a number of computerized information files and computer programs to store, retrieve, print, and map information that has been recorded by location. Computer programs have also been provided to perform various arithmetric and statistical operations on the stored data and to produce reports that are useful in performing geographic data analysis.

The GIS stores a great variety of data useful for planning by location in the county. It is based on metric system measurement as information is recorded within four-hectare square grid cells (equivalent to 10 acres); about 64,000 such cells are required to encompass the entire county. These are located within a 350-row by 450-column rectangular grid.

While the basic file structure consists of grids, the GIS permits users to aggregate or enter data for larger geographic areas such as municipalities or census districts, and thereby allows analysis at either of these geographic levels. This makes the system extremely useful for a great variety of descriptive and analytical tasks for planning purposes.

The GIS consists of five sets of data files and a "library" of computer programs to manipulate the data to produce reports or maps. The system will provide local decisionmakers with natural, human, and economic resource information in a format which will allow easy analysis of an array of complicated data.

The system, as installed on the county's computer, is designed so that new data can easily be added and current data files can be updated, as needed. There are 23 source data files at present. A listing of these files and a tentative schedule for updating them is shown in Table IV.6. In addition, the Lancaster County Planning Commission plans to copy all files periodically in order to make comparisons of changes over a long period of time.

It is anticipated that the system and its programs will serve as extremely useful planning tools. Use of the programs by county and local planners and officials will facilitate both short-range and long-range planning. By predicting the potential impact of a local subdivision plan, a major loss of agricultural land, or other action, the system can help local decisionmakers in implementing their plans and programs.

TABLE IV.6
TENTATIVE SCHEDULE FOR UPDATING SOURCE DATA FILES
ON GEOGRAPHIC DATA SYSTEM

Source 01 - Political Subdivisions	Review Annually
Source 02 - Census Districts	Decade Basis
Source 03 - Water Service Areas	Annually
Source 04 - Sewer Service Areas	Annually
Source 05 - Land Cover	3-5 Years
Source 06 - Public Places	Review Annually
Source 07 - Zoning	3 Months
Source 08 - Geology	Not Required
Source 09 - Soils	If New Surveys Are Done
Source 10 - Major Roads	Upon New Construction or Reclassification
Source 11 - Bus Routes	Annually
Source 12 - Rail Rights-of-Way	Annually
Source 13 - Flood Plains	Not Required
Source 14 - Watersheds	Not Required
Source 15 - Historic Places	Annually
Source 16 - County Comprehensive Plan	Only When Plan is Updated (5-10 yrs.)
Source 17 - Rural Delivery Route Areas	Annually
Source 18 - 1979 Land Development Activity	Not Required
Source 19 - 1980 Land Development Activity	Not Required
Source 20 - USGS Quadrants	Not Required
Source 21 - Power Line Rights-of-Way	As They Occur
Source 22 - Combined Sewer and Water Service	Annually
Source 23 - Agricultural Uses	Same As Land Cover (5 Years)